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CONVENTION OF THE NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION.

During the past twelve months a mighty effort has been made to increase the membership roll of the National Electrical Contractors' Association. It is understood that during the past year there was a gain of nearly one hundred per cent and this has placed the organization in a much firmer and more formidable position than ever before. For many years the contractors, while being good fellows among themselves, for some reason or other held aloof to a considerable extent from the manufacturers' representatives, the supply men and jobbers, and the representatives of the technical press who had the hardihood to attend their conventions. No one has given much thought to the reason for this, but everyone has commented upon it and knew that it surely existed. For the last two or three years there has been a tendency to fraternalize on a broader scale, and the convention this year under the able leadership of Marshall L. Barnes, happily re-elected president of the association, was enjoyable from every point of view, but enjoyable mostly because every element in the electrical industry got into the melting pot and there was evident at all times a spirit of free-masonry and friendly co-operation that will mean more to the contractors and to the industry in general than anyone yet realizes.

The questions of moment to the contractor in his relation with the manufacturer of electrical apparatus and the labor organizations which control the men the contractor has to employ to look after his installation details, occupied considerable time in the closed sessions. While the discussion of these and other matters were kept pretty securely locked up, some of the essentials leaped over into and obtruded upon the general sessions. Consequently, during the session on Thursday morning there was a refreshing and openhearted discussion of the relation of the contractor to the manufacturer with respect to the question of wholesale prices. It is not our duty or privilege to advocate, but it is our function to chronicle and if possible foretell in a way the tendency of the times. This question of resale prices, so far as the contractor is concerned, is as old as the business, but it has been booted and muddled and when it has been brought up many hands have reached out to throttle it and keep it from attracting too much attention. However, it is very apparent that a change is coming over the situa-

tion. The contractor today in many parts of the country represents a buying power that must surely be reckoned with. There are a number of manufacturers today who are more than willing to deal directly with a contractor and give him the benefit of the best price he can make, and as a matter of fact some manufacturers are already doing it. On the other hand, there are thousands of contractors, even members of the National Electrical Contractors' Association, who are not now, and will not for some time to come be entitled to wholesale prices on materials and supplies. Through the cooperation of the manufacturer, the contractor, the central station manager, and the jobber in electrical supplies, all of these matters may be harmoniously worked out. Through cooperation the development of the industry will be engendered. As we have pointed out time and time again it will be largely through the efforts of the commercial department of the central station that the network of the power company will be increased. The jobber handling electrical supplies is dependent upon this increase in the network for the resale of his current-consuming devices and the contractor is also dependent upon this increase in the network for the new business which keeps his installing force busy. Incidentally the new installations or increased sale of current-consuming devices to accommodate the increasing network of distribution affects the manufacturer directly.

The entertainment features of the convention were decidedly enjoyable, and the committees in charge are to be congratulated upon the very satisfactory way in which each event was concluded.

The degree team of the Sons of Jove, under Statesman Brock, deserve the commendation of all good Jovians for the very decent and dignified rejuvenation and joviation on Wednesday evening.

THE FUTURE OF THE ELECTRIC SIGN.

No better field exists for the development of central-station lighting revenue than that provided by the electric sign. Window lighting is properly included in this class of service, which broadly covers the entire field of illuminative publicity. Volumes might be written concerning the detailed applications of electric signs, but a night trip down Broadway, New York City, or an evening spent in any of the larger cities where co-operation has been established between the central-station interests and the public authorities in the direction of sign installations, is sufficient to show what may be done by vigorous campaigning. One thing is certain, and that is that the electric sign is bound to come into its own within a few years to a degree as yet unsuspected by many central-station managers.

One hears more or less about the artistic problems of electrical advertising, and in the long run there is not much doubt that present crude installations will be obliged to give way to designs which will pass the test of the soundest taste. Fortunately there are now plenty of illustrations of thoroughly good work which set the pace for that which is to come. The experienced electric-lighting man has little to fear on the esthetic side of the sign problem when he considers what is now being done in connection with such monuments of architecture as the latest railroad terminals and public libraries. Even the church is pressing the electric sign into its service without sacrifice of good taste, and given skilled designing, there seems to be no field which cannot be utilized by electricity, provided the fundamental requirement of stating a message is met in a tasteful way.

A word about the benefits of the sign and window lighting load may not be amiss. This business tends to overlap the period of heaviest demand on the central-station system, and for perhaps an hour or more in the evening is objectionable in its relation to the necessary investment in station capacity and distribution equipment. Every company must decide for itself how far it will cultivate lighting business which in part at least overlaps the time of maximum load, but it is worth remembering that modern generating machinery is built to withstand severe overloads for one or two hours and usually 150 per cent of the normal rating can be carried for such periods without difficulty. Recent studies of station performance under severe conditions tend to show that plant economy is far less affected by heavy overloads than by underloads. It is a fairly safe guess, therefore, that with modern turbo-alternator equipment, it will pay commercially to carry practically any load which can be handled for one or two hours, and this means that a large sign business can profitably be cultivated in many cities, even though the resources of the plant may be a bit strained for an hour or two daily to carry the load steadily. There is always a tendency for the engineer to look at the technical side of questions of this kind without due regard to the problem of securing additional revenue; and hence it is desirable to realize again and again that additional gross earnings—so long as they can be had without interfering with the quality of the service—are more necessary to the ultimate success of a station than refinements of economy within the power house. This is a hard saying, but it is a true one, and without deprecating the value of efforts to cut down the cost of manufacture and distribution, the central-station officer whose hand is on the executive wheel may well seek enlargement of gross income through sign and window lighting as vigorously as he may endeavor to reduce the cost of sending forth a limited output of energy.

Electric-sign development calls for a larger utilization of high-efficiency lamps than has heretofore been evident. Permanent success in this direction implies the better selection of lamp sizes and spacing as well as the adoption of filament types which enable the operating company to deliver the requisite amount of light with the least possible expenditure of energy. Little excuse exists for the continued use of small carbon sign lamps with a consumption of per-

haps four watts per candlepower, when the more brilliant and strikingly effective tungsten lamp of well under 115 watts rating is available, especially in the lower voltages, with correspondingly thick and rugged filaments. Mistakes have often been made along the line of using sign lamps of too high candlepower, and it is worth noting that a two-candlepower lamp installation, well separated in the sign structure, will produce a much better effect than a larger-unit equipment whose assembled letters are blurred by too close spacing.

More and more the tendency is apparent to carry sign and window lighting campaigns forward on the basis of flat rates. There is no reasonable objection to this from the accountant's side of the office, since the energy consumption can be metered at any point on the system which the company desires, or the consumption approximately checked by frequent test readings. The consumer of sign and window-lighting current is not in the least interested in watt-hours and lamp efficiencies, but he does care a great deal about the amount and quality of light and the size of his monthly bill for such service. The use of the more efficient lamps is almost imperative where flat rates apply, and both the station and the consumer are benefited by the fact that with the metal filaments so much more light can be delivered and in such a better way than with the older lamps. In many a small town it is hard work starting a sign and window-lighting campaign, but if the start is made right, the business is certain to grow through the potent forces of local competition, civic pride and co-operation between the company and the municipal authorities.

THE CURRENT TRANSFORMER.

Compared to a generator or a motor the transformer is a simple piece of apparatus. Its theory has been quite fully worked out; its characteristics are well known, and the design has been almost completely standardized. For use in connection with measuring instruments the transformer has found a wide field, and both the potential transformer for use with high voltages and the current transformer for use with large currents have become indispensable.

While the characteristics of the current transformer have been fully investigated from the experimental side, the relation of these characteristics to the properties of the material from which the transformer is constructed have not heretofore been shown. In an article which is concluded in this issue, Dr. P. G. Agnew has investigated from both the theoretical and experimental side the relation which exists between the core loss of the current transformer and the operating ratio and phase angle. He finds that the shape of the ratio curve and the phase-angle curve can be predetermined from a knowledge of the core material, and he has pointed out how this knowledge may be applied to securing a transformer whose values of these important quantities will be but slightly affected by the magnitude of the current flowing.

In transformers which are to be used with measuring instruments it is highly desirable to obtain constancy in ratio, particularly over the working range of currents used. While this has been fairly well realized in some transformers, it has not heretofore been shown how this characteristic depends upon the core loss of the transformer. Dr. Agnew's work should be a great help to future designers in pointing out how they may reach the desired goal. Although by securing iron for the core with the proper constants it is possible to secure an almost constant ratio with a definite secondary circuit, the value of the ratio will still be affected by any change made in the load of the secondary. Nevertheless, measuring transformers are more often used with a definite secondary circuit, and a single calibration is sufficient to give the value of the ratio under these circumstances. If the ratio can be made independent of the current a great advantage is obtained.

ELECTRICALLY OPERATED SHOVELS.

While attempts have been made to supplant the steam shovel by an electrically operated shovel, the results so far have not been a pronounced success. One of the causes for this has been the fact that motors which are used in this work must be so frequently stopped and reversed. In his recent talk before the Electric Club of Chicago, as reported upon another page of this issue, Mr. George Patnoe pointed out that an electric shovel of the same size only had a capacity of about sixty per cent of that of the steam shovel, on account of its slowness in operation. Nevertheless he expressed his faith in the future possibilities of an electrically operated shovel, giving as a reason for past failures the fact that electrical engineers had not been conversant with the requirements of this kind of work. On the other hand, the men who have operated steam shovels and are conversant with the requirements of the work have not been men with sufficient knowledge of electrical engineering to design an electrical apparatus. He indicated that a solution would come through the use of a motor which is kept in continuous operation, with clutches for starting up or stopping the shoveling apparatus.

When it is considered that, in rolling-mill work, motors of very large capacity have been designed which can very quickly reverse the rolls, it does not seem that the objection mentioned above should be an insuperable one in the operation of an electrical shovel. This matter offers an inviting field to the electrical designer, with a probability almost amounting to certainty that the problem can be successfully worked out. The opportunities for applications of a successful design are innumerable. In the plant described by Mr. Patnoe the quarrying apparatus is operated exclusively by electrical energy, and with few exceptions these adaptations are considered highly satisfactory.

The Use of Electrical Energy in Quarrying.

The meeting of the Chicago Electric Club on July 19 was devoted to an address by George Patnoe on "The Use of Electrical Enegery in Stone Crushing and Quarrying." Mr. Patnoe has designed, constructed and operated the equipment of the Dolese & Shepard Company, which is located along the drainage canal of the Sanitary District, Chicago, Ill., and his talk consisted of a description of this plant, of which he is superintendent. The product is crushed stone.

In rebuilding this plant after a recent fire it was decided to use electric power, especially because the plant covered considerable ground and independent operation of parts was desired.

The operations chiefly considered by Mr. Patnoe were drilling, loading cars and conveying, shoveling and crushing. Compressed-air drills have been entirely replaced by electric drills, which are operated at half the previous cost with an output twenty-five per cent greater. These drills are an entire success. Motor-driven cars are operated on a third-rail system with independent distant control. In this way twenty-five cars with a capacity of 6,000 to 8,000 tons daily are operated by two men. To do the same work seven steam locomotives would have been required. The cars hold twenty tons each, and run up a six-per-cent grade to a height of seventy feet at the crusher. On the return, the cars are electrically braked, the motors being connected to a dead resistance. Cast-iron grids were at first used, but the breakage due to jars caused trouble, the cars sometimes running away. Now No. 6 "Climax" wire is used, giving entire satisfaction.

No trouble has been experienced with any of the electric motors used. Electrically driven shovels were tried but were not successful, owing to their slowness of operation, which was conditioned by the necessity of stopping the motors for reversal.

Fifteen tons per hour can be handled by the crusher. Rolls are used for reducing below six inches in size. The main crusher can take pieces up to a size of eight by three feet. Storage bins are provided for the different sizes and from these seventy freight cars can be loaded per hour. Current is obtained from the Economy Light & Power Company, of Joliet. Reserve supply is afforded by connection to the lines of a second supply company. 1,200 kilowatts are necessary to operate the plant. The current is transformed to 440 volts for supply to the induction motors. Motor-generators render direct current also available.

At the conclusion of the address, James H. Delany added some particulars regarding the conveyor system, which had not been covered by the speaker, and spoke of the enormity of the work accomplished.

California Electrical Contractors' Convention.

The second annual convention of the California State Association of Electrical Contractors was held at Catalina Island, near Los Angeles, July 10 to 15, under the auspices of the Los Angeles and Pasadena chapters. About 125 delegates from various parts of the state were in attendance.

Business and technical sessions were held on Tuesday, Wednesday and Thursday, the remainder of the week being devoted to recreation. On Thursday evening the annual banquet was given at the Hotel Metropole.

Friday was celebrated by the members and ladies with a picnic and barbecue, accompanied by a program of outdoor sports. Saturday was given over to fishing.

The following officers were elected: J. C. Rendler, president; C. H. Heilborn, first vice-president; W. S. Reynolds, second vice-president; W. S. Hanbridge, secretary and treasurer; R. L. Booth, sergeant-at-arms.

The next convention will be held at San Jose.

Receivers for the Platt Iron Works Company.

On the application of creditors and with the consent of Joseph B. Reichmann, president of the concern, receivers were appointed on July 24 by Judge Hollister in the United States District Court at Cincinnati, for the Platt Iron Works Company, of Dayton, Ohio. The purpose of the action, it is said, is to stem the tide of the creditors until the vast sum due the company on open accounts can be collected. President Reichmann filed an affidavit admitting the inability of the company to pay its debts.

The papers include a statement showing an unsecured indebtedness outstanding of $1,293,000 and secured indebtedness of about $350,000. It was stated that the company has $850,000 of uncompleted or unfilled orders on hand. The aggregate amount of accounts receivable, according to the bankruptcy papers will reach about $400,000. Action was taken on behalf of the Randolph-Clowes Company of Waterbury, Conn.; the Sundh Electric Company of New York, and the Mercantile National Bank of New York.

American Electric Fuse Company To Continue.

It has been decided to continue the business of the American Electric Fuse Company until such time as it can be sold. Edwin C. Robinson, of Muskegon, C. C. Cleverton, of Muskegon, and Frank Hirsch, of Chicago, have been named to conduct the affairs of the creditors and Paul S. Moon has been elected a member of the board of trustees to represent the creditors. John G. Emery has been elected to an advisory position on the same board.

The action was taken at a meeting of about twenty creditors and creditors' attorneys of the company held at Muskegon on July 14. The meeting was presided over by Kirk E. Wicks, of Grand Rapids, referee in bankruptcy.

It was ascertained that if the company were to be closed up at the present time the creditors would get practically twenty-three cents on the dollar.

Plan for New York Subway Work.

In a letter addressed to the Board of Estimate of New York City, Seth Low strongly advocates an agreement between the city and the Interborough Rapid Transit Company to the end that they may assist properly in the work of subway construction. Mr. Low believes that an agreement can be made with the Interborough Company substantially on the following terms: That the Interborough Company shall agree to furnish $75,000,000 of new capital, more or less, for the construction and equipment of that part of the McAneny plan assigned to it, if the city in any way that may be found legal will permit it to earn three per cent above interest and amortization charges on its old and new private capital.

Calvert Townley.

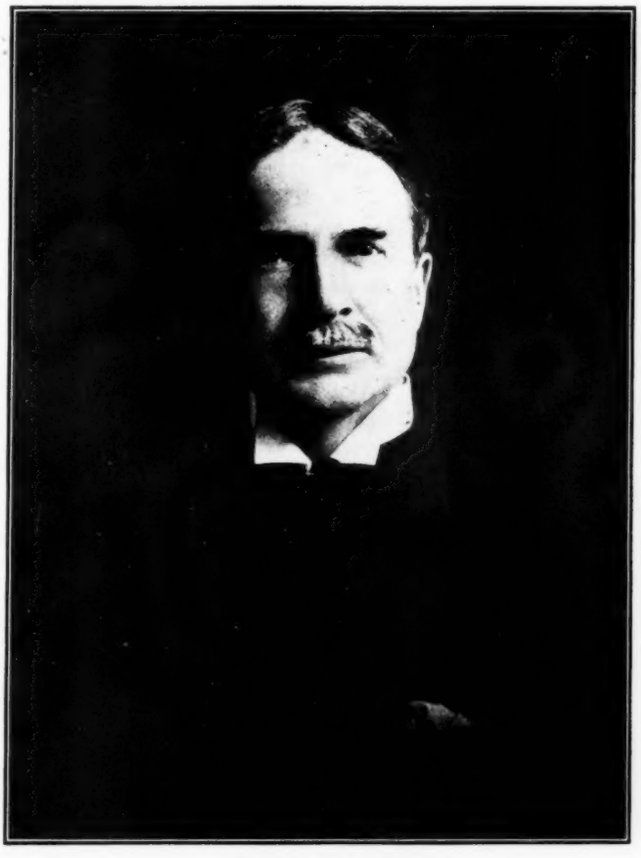
In reaching a decision to equip the electrified lines of the New York, New Haven & Hartford Railroad system with high-tension, single-phase, alternating-current apparatus, Calvert Townley was probably of as great an influence as any other individual connected with this great undertaking.

Mr. Townley entered the electrical field at the time when the alternating-current system was in its beginning, and he has given the matter his very close study, and is today one of the best informed men on this subject in the country. His early experience combined both commercial and engineering matters, and his engineering training and the connections he has established had given him an understanding of electrical apparatus and electrical operation which has made his administrative work very practical and highly effective.

Mr. Townley was connected in various capacities with the Westinghouse Electric interests for seventeen years, and during that time he contributed very materially to the large measure of success which has attended the commercial development of the apparatus designed and manufactured by that company.

For the last six years, until very recently, Mr. Townley has been connected with the New York, New Haven & Hartford system, going to New Haven originally to take charge of the electrical work for the system, and also manage its trolley properties. During the illness of Vice-President McHenry, Mr. Townley organized and conducted the investigation of the electrification problem out of New York, and had completed the preliminary studies, adopted a general plan, and issued some of the specifications before his recovery. Since that time the work has been divided, and Mr. Townley's attention has been devoted almost entirely to work in connection with the various lighting and trolley properties which have come under the control of the New Haven interests.

Within the last few months, Mr. Townley severed his connection with the New Haven system to reenter the services of the Westinghouse Electric & Manufacturing Company on the staff of Chairman Mather. While Mr. Townley's personal tastes have always been of the engineering nature, his great capacity for attention to detail and for the handling of men and systems has marked him continually for positions wherein his executive ability might have opportunity for employment.



CALVERT TOWNLEY,
Engineer and Executive.

Melting Carbon.

Moissan came to the conclusion that carbon could only be liquefied under high pressure. Doubt has existed as to the correctness of this conclusion, and experiments have recently been reported by La Rosa in the *Annalen der Physik* indicating that carbon may be melted at ordinary pressure. He made use of carbon rods from one to three millimeters in diameter. These were very carefully purified and then placed in a circuit in which the current was gradually raised until they became incandescent. The current was then suddenly raised to the highest value available, which was about ninety amperes. This caused the rod to explode. When the fragments were examined it was found that they had been converted to graphite, that the smallest pieces were round and that the larger ones had rounded corners and spherical protuberances, indicating that the material had been in a molten condition. These results were even more pronounced when the apparatus was covered with porcelain. The latter was then coated with particles that appeared to have impinged upon the surface in a molten condition and there frozen. These experiments are interpreted to mean that the carbon had begun to melt.

The Resistance of Insulators.

An investigation of the resistance of different forms of insulating material has recently been carried out by W. Dietrich, who has reported the results in the *Physikalische Zeitschrift*. The materials to be tested were in the form of cylindrical rods, which were connected to a charged electroscope and the rate of leakage observed. The insulation of hard rubber, caoutchouc, sealing wax, paraffin, etc., were found to be affected by the action of light, the material apparently acquiring a surface conductivity. Moisture had a similar effect upon shellac, paraffin, beeswax, sealing wax and resin. Different kinds of wood were also investigated. When dry their insulation stood in the following order: pine, walnut, fir, beech, oak. When in a moist condition the order of insulation was oak, walnut, pine, fir, beech. In investigating different kinds of glass it was found that a gradual rise in temperature resulted in a gradual fall of resistance.

Railroad Electrification in Austro-Hungary.

The Austro-Hungarian Government is considering the question of electrifying the State railways, and has appointed two experts, one to visit England and the other the United States, in order to report what has been achieved in electric railroading in those countries.

Wire Men Accept Sentence and Are Fined.

Thirty-seven of the eighty-three men indicted by the grand jury, United States Circuit Court, New York City, on June 29, in connection with the Government's activity against the so-called "wire trust," withdrew pleas of not guilty and accepted sentence, without trial, on pleas of nolo contendere, at New York, on July 25. This plea by the defendant in a criminal prosecution, without admitting guilt, submits him to a judgment of conviction, but does not preclude him from denying the truth of the charges in a collateral proceeding.

Judge Archbald, in the United States District Court, imposed fines of from $1,000 to $1,700 and costs in each case, the provision having been made that where a defendant had been fined in one case the fine should be $100 for each additional case.

Francis Rawle, of Philadelphia, counsel for F. W. Roebling, of Roebling's Sons Company, of Trenton, N. J., is quoted as saying: "All of the men under indictment acted under the advice of counsel and all gave up the association which has been pronounced in defiance of law as long as eighteen months ago, and in some instances three years ago. This was done in good faith, as at that time no one knew just what the provisions of the Sherman act meant."

Judge Archbald in accepting the plea of nolo contendere, remarked:

"We know now exactly or very nearly exactly what it means, and from this time on there will be no excuse, but I feel justified in looking at what has occurred in the past in this light, and therefore I certainly regard this as calling for nothing except a proper vindication of the law by a fine."

The indictments were returned as announced in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN, July 8, on June 29 by the United States Grand Jury against the officers of the American Steel & Wire Company and thirty-five other corporations and partnerships. Among those indicted were Frank J. Gould, president of the Old Dominion Wire & Nail Works; William P. Palmer, president of the American Steel & Wire Company; Herbert L. Satterlee, president of the Habirshaw Wire Company; Ferdinand and Carl Roebling of the Roebling's Sons Company, and Erskine Hewitt, secretary of the Trenton Iron Works. The list of the defendants fined is:

$1,700—F. W. Roebling.

$1,500—Frank J. Newberry, Joseph W. Marsh, William A. Conner, Philip H. Smith.

$1,400—Charles J. Marsh, Frank N. Phillips, Charles R. Remington.

$1,200—Theodore F. Ryan, John C. Bridgman, Henry H. Ashley.

$1,100—W. F. Fields, Alfred F. Moore, James H. Mason, Alfred A. Cowles, Russell A. Cowles, Thomas Wallace, Louis Anschutz, Joseph C. Belden, Edward L. Frisbie Jr., Thomas B. Kent, C. Edward Murray, A. M. Dickinson, Karl Roebling, Antoine Bournonville, Charles A. Morss.

$1,000—Newell B. Parsons, James A. Doughty, George P. North, Robert W. Sieberling, Robert E. Lucas, R. Eccleston Gallagher, William H. Hall Jr., Ralph Watrous, George L. Bowen, Everett Morss, Frank M. Potter, Jr.

The nine associations in one or more of which the indicted men are members, are:

Telephone Cable Association, the Bare Copper Wire Association, Weatherproof and Magnet Wire Association, Fine Magnet Wire Association, Horseshoe Manufacturers' Association, Underground Power Cable Association, Rubber Covered Wire Association, Lead-Incased Rubber Insulated Cable Association, the Wire Rope Manufacturers.

Rates in Los Angeles.

The lighting and power rates adopted in May by the Board of Public Utilities, on the suggestions of its engineers, after investigation by a special committee from the City Council conferring with E. F. Scattergood, chief engineer of the city power bureau, have been changed to the following:

Light, per month, minimum charge, seventy-five cents; 10 to 250 kilowatt-hours, seven cents; 250 to 500 kilowatt-hours, six cents; 500 to 1,000 kilowatt-hours, five cents; 1,000 to 2,000 kilowatt-hours, four cents; 2,000 to 4,000 kilowatt-hours, three cents; in excess of 4,000 kilowatt-hours, two and three-quarter cents.

Power, per month, first 100 kilowatt-hours, seven cents; 100 to 300 kilowatt-hours, six cents; 300 to 500 kilowatt-hours, five cents; 500 to 1,000 kilowatt-hours, four cents; 1,000 to 1,500 kilowatt-hours, three cents; 1,500 to 2,000 kilowatt-hours, two and one-half cents; 2,000 to 3,000 kilowatt-hours, two cents; 3,000 to 4,000 kilowatt-hours, one and one-half cents; in excess of 4,000 kilowatt-hours, 1.4 cents. The minimum charge is fifty cents per month per horsepower installed, and not less than $1.00 a month in any one case.

Save for the present minimum of $1.00, which is reduced to seventy-five cents, the rates are practically the same as those which have been in force for the past year. The new rates will be embodied into an ordinance and passed by the City Council and will become effective in August.

Co-Operative Electrical Advertising.

The excellent and effective plan of newspaper co-operative electrical advertising inaugurated two years ago in Cleveland, O., and known in that city as the "People's Electrical Page," has begun to take root in a number of other cities. Newspapers in Dayton, O., Youngstown, O., and Washington, D. C., with the co-operation of the central stations and other electrical companies, have started to publish at regular intervals electrical pages. The essential feature of such a page is a central block of live, readable editorial matter on the application of electricity for commercial and domestic, with a fringe of advertisements placed by electrical concerns. The page is prominently titled and it attracts a great deal of attention, due to the coherent placing of the news and advertising features.

The success of the "People's Electrical Page" in Cleveland is due largely to the efforts of J. Robert Crouse of the National Electric Lamp Association. It has been arranged that any society, club or association may obtain free a framed copy of a typical issue of the "People's Electrical Page," labeled "A Notable Example of Co-operative Advertising," by writing to Philip S. Dodd, 1818 East Forty-fifth Street, Cleveland, Ohio.

National Electric Light Association Convention.

The next annual convention of the National Electric Light Association will be held at Seattle, Wash., if present plans are carried out. The date of the convention has been set for June 10-14, 1912.

Generating and Pumping Stations on the Columbia River.

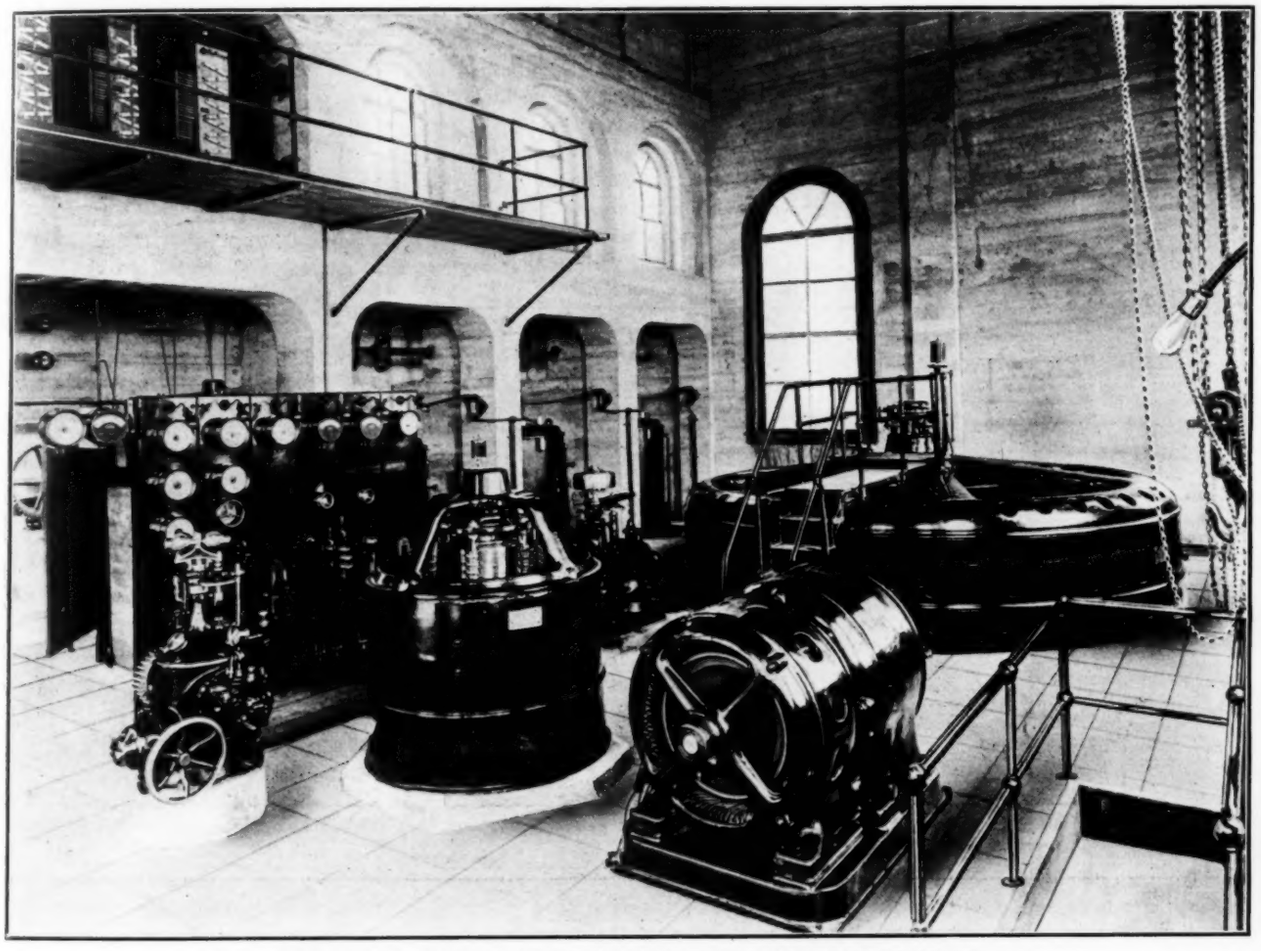
Priests Rapids Development of the Hanford Irrigation & Power Company.

The installation here described is noteworthy in illustrating a highly economical and efficient method of utilizing low-head water powers which are subject to extreme variations in head resulting from flood conditions. It also shows an excellent example of modern engineering practice in irrigation work where the head is insufficient or the topography makes it impossible to deliver water to the surrounding country by gravity. In such cases it has been found possible to generate electrical power at one point on a river and transmit it to electrically operated pumping stations located at other points on the river, as desired. These take water from the same river and elevate it to high-level irrigating ditches.

The principal consideration affecting the design of the power station was that of the extreme variation between low water and flood level, the minimum head being eighteen feet and the maximum twenty-seven feet. In order to place the generator and electrical apparatus above the highest flood water, vertical triplex units were adopted. By choosing a triplex turbine, a suitable speed was obtained for direct connection to the generators.

By means of step-up and step-down transformers and a pole line, power is transmitted from the generating station sixteen miles to a pumping station down the river, where induction-motor-driven single-stage centrifugal pumps deliver the water from the river into irrigating ditches. This pumping station is built for four pumping units, two of which are now installed and in operation. The total power available at Priests Rapids will permit the installation of several other pumping stations at some future time, located as required by the demand for irrigating water, and all obtaining their power from the central generating station.

The power station is located at Priests Rapids on the Columbia River in Yakama County, Wash., near the Benton County line. The river in this section flows in a southeasterly direction for some miles and then makes a wide sweep to the south and west, which direction it follows till it reaches the Pacific Ocean. At the point where the plant is located, the river forms what are known as Priests Rapids. By means of a dam, reservoir and canal, protected from the river by retaining



INTERIOR OF POWER HOUSE, SHOWING GENERATORS AND EXCITERS.

wall and embankment, provision was made for an ultimate development of 9,800 horsepower from a minimum head of eighteen feet. A total of about 90,000 horsepower is available from the river at this point. The present power station is designed for a normal capacity of 2,600 horsepower.

The dam was built across the southern channel of the river, through which, at low water, there is a flow of about 12,000 cubic feet per second. A short distance above the dam, an intake 140 feet wide and 700 feet long connects the river with a natural lagoon and uses part of the water backed up by the dam. This lagoon is from one to seven feet deep at low water and three-quarters of a mile long. At its eastern end, a canal about a mile in length carries the water to the power-house intake. Gates were installed at the junction of the lagoon and the canal to regulate the supply of water and a retaining wall and embankment were built from the dam along the lagoon and the length of the canal to afford protection from the river. By extending the wing dam up along the island, which divides the main channel from the one across which the dam was built, it will be possible to economically increase the head two feet at low water. This head could, of course, be further increased by extending the dam farther up the river, which may be done as the demand for power increases.

The canal extends about a mile from the power-house intake to the head gates at the lower end of the lagoon. It is sixty-seven feet wide with side slopes 1.5 to 1, except for a short distance in the rock where it is only sixty feet in width. The excavation for the canal amounted to about 175,000 cubic yards, nearly all of which was earth and coarse gravel.

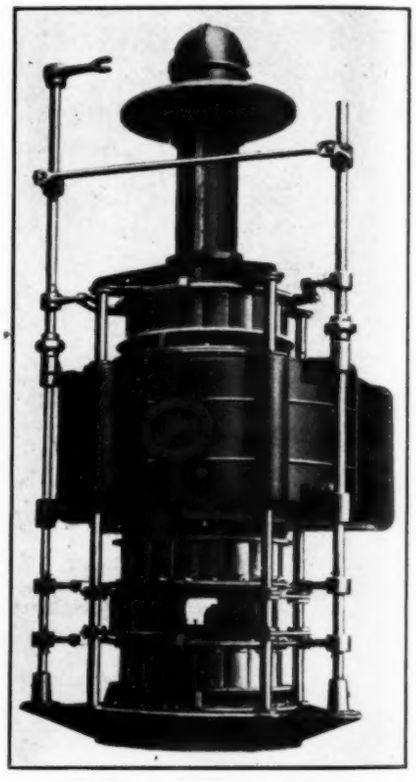
An embankment was built to afford protection to the lagoon and the canal from the river. This extends about two miles from the intake at the upper end of the lagoon to the power house. The first 4,000 feet of embankment below the intake has a timber bulkhead on the river side, while a 1.5 to 1 slope is maintained on the canal side. The top is eight feet wide. The posts supporting the bulkhead are 8-by-10-inch Washington fir, set one foot in bed rock and eight feet apart, and anchored by one-inch rods to deadmen buried in the embankment. The sheeting is 5 by 12, 4 by 12, and 3 by 12 inches, all sixteen feet long. The remainder of the embankment, about 6,000 feet, is eight feet wide on top with a 1.5 to 1 slope on both sides. The river side is covered with a layer of loose rock six feet at the base and tapering to a point near the crest. All of the embankment was built with material excavated from the canal.

The canal head-gates are made up of ten gates of the butterfly type and one pad-gate. Each of the butterfly gates is eighteen feet long with a vertical depth of seven feet measured from the canal bottom. The planking above the gates extends twelve feet vertically and is supported by bents eighteen feet apart. The gates swing on a horizontal shaft supported by three low bents and are operated by means of continuous cables attached to the top of the gates. These pass through pulleys fastened to the base and about seven feet from the downstream face of the gates. The cable then passes over a windlass at the top of the bents and back to the gates. By operating the windlass, the gates can be pulled down to a horizontal position to open and by reversing the operation they can be raised slightly when the excess of water pressure on the lower half of the gates, assisted by the current, aids the windlass in closing the gates tightly.

The general design and construction of the power house may be seen in connection with the plan and sectional views shown. The substructure is of reinforced concrete resting on bed rock, and is about sixty-seven feet square at the foundation. Owing to the extreme fluctuations of the water level of the river, it was necessary to place the generating floor fifty-eight feet above the lower draft floor.

The excavation for the entire building consisted of 6,000 cubic yards of earth and 2,000 cubic yards of solid rock which was all accomplished by hand. The headrace wall was extended fifty feet on each side of the building, thus providing for the future in-

EXTERIOR OF POWER HOUSE.

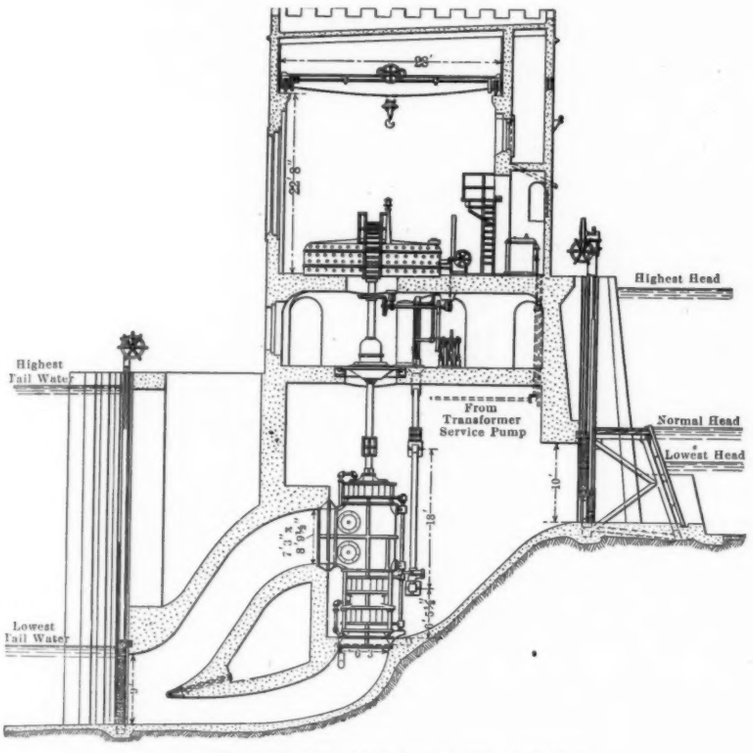


VERTICAL TRIPLEX TURBINE.

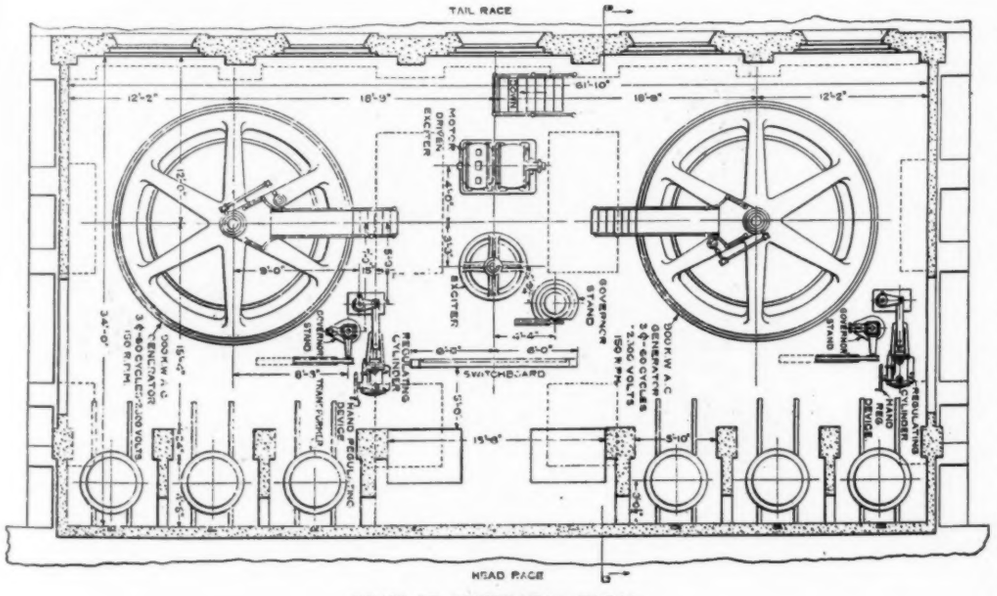
stallation of four additional generators.

The lower draft tubes are eleven feet below the low-water mark of the river. Both the thrust bearing and generator floors are of concrete reinforced with steel beams and rods and arched so as to carry the weight of the generators, thrust bearings and other apparatus.

The superstructure is reinforced concrete with a flat concrete roof thirty-two feet above the generator floor, giving the building a total height of ninety feet. The pilasters support beams which carry a ten-ton hand-operated crane running the length of the station.



TRANSVERSE SECTION OF POWER HOUSE.



PLAN OF GENERATOR FLOOR.

The transformers are placed in a bay built on the headrace side of the building. An outgoing line tower for the high-tension lines and lightning arresters is located above this bay. The low-tension busbars are placed in the bay above the transformers.

A vertical-shaft bilge pump is supported on two I-beams placed just inside the building on the tailrace side over the exciter-turbine draft tube. This pump is used to empty the water in the main and exciter-turbine wheelpits and is driven by a fifteen-horsepower, direct-current motor mounted upon the thrust-bearing floor. Another smaller pump of the same type, supported a few feet above the main bilge pump and driven by a belt from the motor shaft, is used to furnish cooling water for the transformers. Concrete compartments for the 2,200-volt oil switches were constructed on the thrust-bearing floor.

The main turbine units have a maximum capacity of 2,000 horsepower. They are of the vertical triplex type, designed to run at 150 revolutions per minute under a normal head of eighteen feet, but guaranteed to operate satisfactorily under heads varying from eighteen to twenty-seven feet. The arrangement of the turbines, as shown in the section view, consists of a twin center-discharge turbine mounted on the same shaft above a single turbine. The twin-turbine runners discharge into a cast-iron center-discharge casing which is rigidly connected by column construction to the lower single turbine which discharges downward. The runners of the first turbine installed are of cast iron and those of the second turbine are plate-steel vance cast into cast-iron hub and girder rings.

The turbine gates are of the swivel or wicket type, operated through shifting rings and links from a heavy gate shaft. This type of gate is much more efficient at part gate than the cylinder gate and is fully as tight when the unit is shut down. The thrust bearings furnished with both generator and exciter turbines are of the standard Allis-Chalmers oil-bath self-contained type and are located on the intermediate thrust-bearing floor. This type of thrust-bearing effects considerable saving in oil over other types and its simplicity makes it economical from

both operating and maintenance standpoints.

The bearing consists of a cast-iron transmitting ring which takes the weight through a nut threaded on the shaft. This ring carries the thrust disks which run in an oil bath on a stationary cast-iron base ring. Adjustment is provided for wear takeup. The bearing is supported on the reinforced concrete beams of the lower floor. Three babbitt-lined steady bearings are supplied for the turbine shaft, one above the lower turbine, another just above the top turbine and the third underneath the thrust bearing. This last bearing is supported by the bulkhead carrying the thrust bearing.

The concrete draft tubes are designed to lead the water from the center discharge casing and lower runner with uniformly decreasing velocity and minimum hydraulic disturbance to the tailrace, thus abstracting the maximum practicable amount of its kinetic energy.

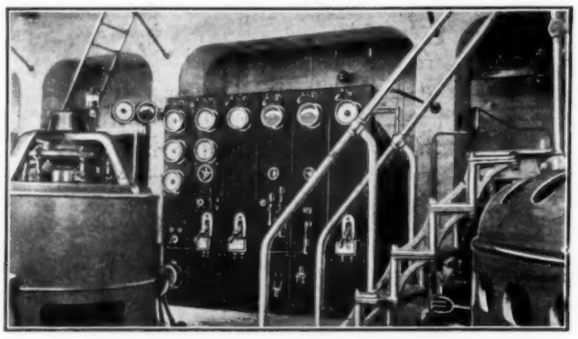
The exciter turbine is a vertical, single-runner, open-flume turbine of 100 horsepower, 225 revolutions per minute direct-connected to a vertical 60-kilowatt compound-wound exciter. Excitation is also provided by means of a motor-generator set of the same capacity.

The head gates are constructed of timbers reinforced by steel beams, provided with cut-rack-and-pinion hand-operated hoists of standard Allis-Chalmers design. They are provided with a filler gate by means of which the water pressure may be equalized before raising the gates. The gates move in channel-bar guides and are protected along their edges by steel plates which reduce the friction and prevent wear. The exciter unit is also supplied with a head gate constructed of heavy timber reinforced with angle irons, and sliding in a structural-steel frame. Tailrace gates are provided for both the generator and exciter turbines, making it possible to pump out the turbine wheel pit for inspection and repair.

The racks are set upon a substantial structural-steel frame securely bedded in concrete foundations and braced back against the building substructure piers. The bars have spacing rods and distance pieces placed back of their centers to allow the teeth of the trash rakes to pass without catching, and are constructed in sections so that they can easily be dismantled for cleaning or repairing.

ELECTRICAL APPARATUS.

A 900-kilowatt, three-phase, sixty-cycle, vertical-shaft revolving-field generator is direct-connected to each of the main turbines. The stator yoke is of cast iron with a special cast-iron base and carries the laminated steel armature core. The stator is carried upon the heavy reinforced-concrete floor arches as shown. A spider is bolted to the top of the stator, which carries the upper steady bearing and the field collector rings.



SWITCHBOARD IN POWER HOUSE.

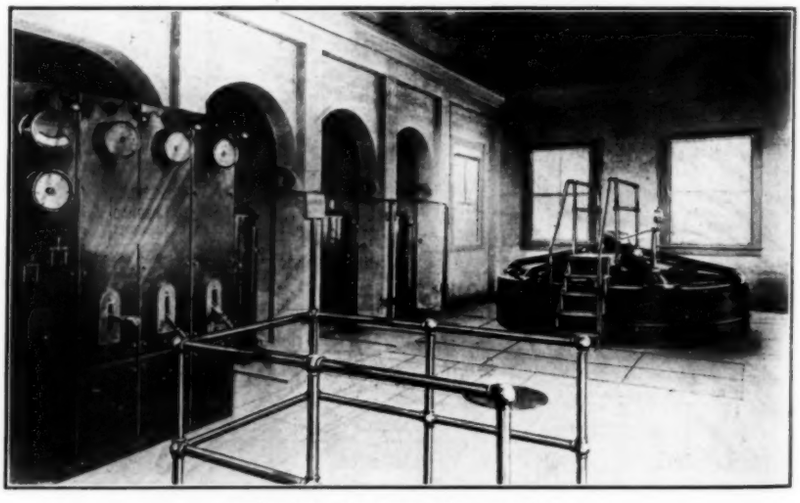
The rotor is of the "umbrella" construction, especially designel to withstand the stresses due to its large diameter and horizontal position. It is mounted on a short shaft coupled to the turbine shaft above the thrust bearing.

The exciter generator is a 120-volt, 500-ampere, direct-current machine, direct-connected to the single vertical turbine previously described. It runs at 225 revolutions per minute. The generator is compound-wound, so as to maintain the voltage constant at 120 volts from no load to full load, and is capable of carrying momentary overloads of seventy-five per cent without flashing or serious sparking. It is of ample capacity to furnish exciting current for two generators of the size of the main units.

A sixty-kilowatt motor-generator set is located on the generator floor of the station and is used as an auxiliary source of exciting current. It runs at 875 revolutions per minute. The adoption of this motor-generator set instead of a second turbine-driven exciter resulted in a considerable saving in space.

The switchboard is constructed of black-enamel slate and is mounted upon an angle-iron frame. It includes two alternating-current generator panels, two exciter panels, one induction motor panel, one transformer panel and one outgoing-line panel. All necessary instruments, switching apparatus, etc., are provided. This includes hand-operated remote-control 2,200-volt oil switches and an electrically operated automatic oil switch for the 22,000-volt line, 22,000-volt lightning arresters and choke coils.

The transformer equipment consists of six 400-kilowatt, oil-filled, water-cooled, delta-connected transformers wound for 2,200 volts primary and 22,000 volts secondary. They are mounted in the bay back of the switchboard. These transformers are capable of carrying a fifty-per-cent overload continuously for twenty minutes without injury and can



INTERIOR OF PUMPING STATION.

safely carry twenty-five-per-cent overload for two hours.

The 2,200-volt oil switches mentioned are located on the intermediate or thrust-bearing floor, and the low-tension 2,200-volt busbars are installed in the bay above the transformers. All of the low-tension wiring is concealed and is carried in fiber conduits.

The pole line connecting the powerhouse to the pumping station is sixteen miles long. The poles are of cedar forty feet in height and placed 142.5 feet apart, guyed with galvanized wire wherever necessary.

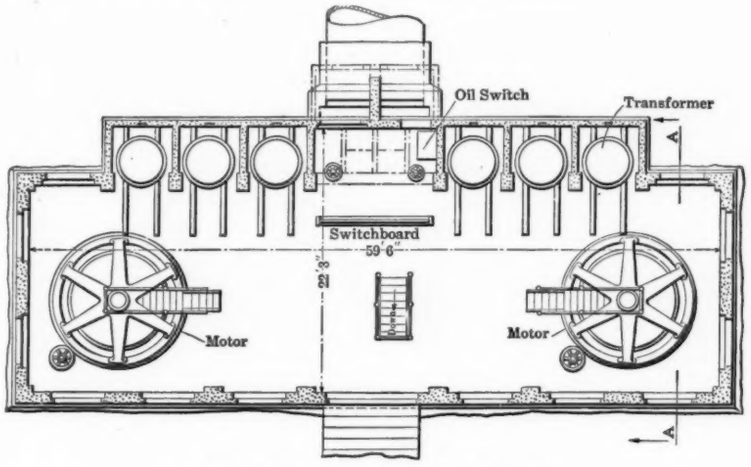
The three-phase current at 22,000 volts is carried on No. 4 B. & S. hard-drawn copper wires spaced fifty-four inches apart and forming the points of an equilateral triangle. The line is transposed once every mile for the benefit of the telephone wires connecting the powerhouse and pumping station, as these are carried on the same poles. The telephone wires are transposed every ten poles.

PUMPING STATION.

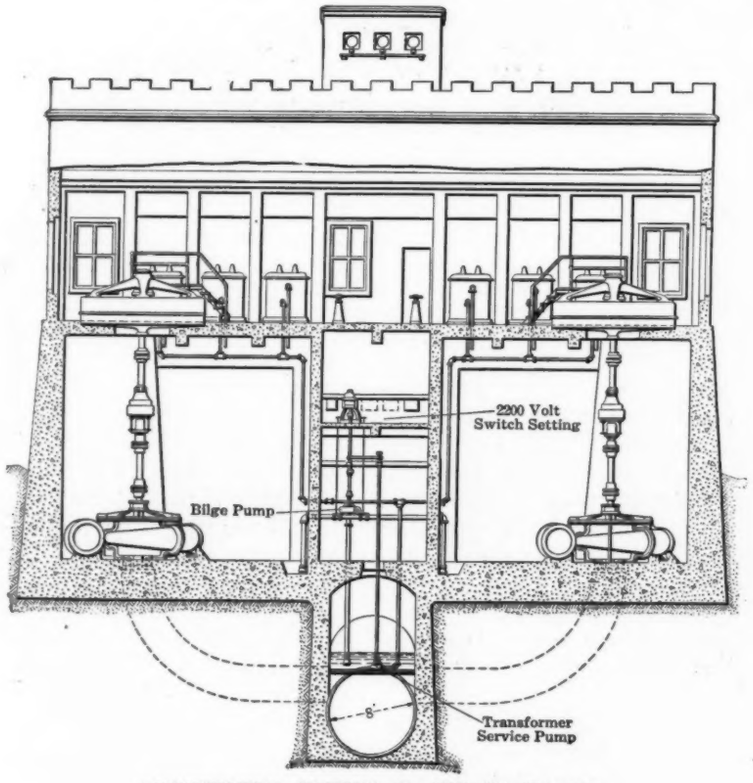
The design and arrangement of the pumping station is shown in the plan view. It is built along the same general lines as the power station. Both the substructure and superstructure are of reinforced concrete. The foundations rest on bed rock and are built high enough to place the main floor above the highest flood level of the river. The station is twenty-five feet wide by about thirty-two feet long and is built with provision for two more pumping units of the same general design as those now installed, with higher head capacity.

The intake tunnel is built of wood and extends about 300 feet out into the river to a point where the intake crib is below the lowest water level of the river. The tunnel is eight feet in height.

A concrete line tower extends from the transformer bay above the level of the roof, similar to the line tower on the generating station. The upper floor carries the two main pump motors, switchboards, transformers and electrical apparatus. The two pumping units now installed are at opposite ends of the station. A hand-operated crane runs the entire length of the building and the crane girders are supported by the building pilasters.



MAIN FLOOR OF PUMPING STATION.



LONGITUDINAL SECTION OF PUMPING STATION.

The intermediate floor carries the thrust bearings, the pump-discharge valve stems, bilge-pump motor, low-tension oil switches and wiring. The suction connections to the main pumps are built in the concrete foundations connecting the suction inlet of the pumps to the intake tunnel.

The main centrifugal pumps are driven by two 450-horsepower, three-phase, sixty-cycle induction motors wound for 2,200 volts, running at 175 revolutions per minute. The stators are built up of laminated steel mounted in a cast-iron frame which carries the lower steady bearings. The upper steady bearings are supported by cast-iron spiders bolted to the frame. The rotors are of the squirrel-cage type, built up of sheet steel and are provided with polyphase windings adapted to the insertion of resistance for starting under load or for speed regulation. These rotors are of rigid construction with allowance for the stresses incurred as a result of their horizontal position.

The switchboard is of black-enameled slate mounted upon a steel frame and consists of two motor panels, one line panel, one lighting panel, and one transformer panel. The oil switch operating the 22,000-volt line is similar to that installed in the main power station, except that it is hand-operated and non-automatic. The me-

chanically operated distant-control 2,-200-volt oil switches, choke coils, etc., are also similar to those in the generating station.

There are three 300-kilowatt 60-cycle, three-phase, 22,000/2,200-volt transformers installed in the pumping station, of the same design as those in the power house, and these are located back of the switchboard in compartments separated by concrete partitions. Space is allowed for the installation of three more transformers of the same size, back of the other side of the switchboard.

The switchboard and transformers are located on the upper floor with the main pump motors. The high-tension 22,000-volt busbars are supported by insulators on the wall back of the switchboard. Lightning arresters are inserted in the high-tension line before connecting to the 22,000-volt oil switches.

The two centrifugal pumps are of the single-stage vertical-shaft direct-connected type designed to deliver 62.5 cubic feet of water per second against a total head of thirty-six feet. They are of the single-suction type, the water being admitted at the bottom and discharged through a horizontal cast-iron spiral casing. The runners are of cast iron and of the inclosed type. Self-alining thrust bearings, carrying the weight of the revolving parts, are supported on I-beams above the pump casings.

Thirty-inch sluice gates are placed at the suction inlet of each pump with an operating valve stem extended up to floor stands and hand-wheels on the intermediate floor. Thirty-inch discharge valves are bolted to the discharge casings of the pump with valve stems also extended up to the intermediate floor.

A vertical-shaft motor-driven centrifugal bilge pump, similar to that in the power house, is located over the intake tunnel on the basement floor and is used both for emptying the intake well and for priming the main pumps. A small pump of similar design, and driven by a belt from the bilge-pump shaft, furnishes cooling water for the transformers.

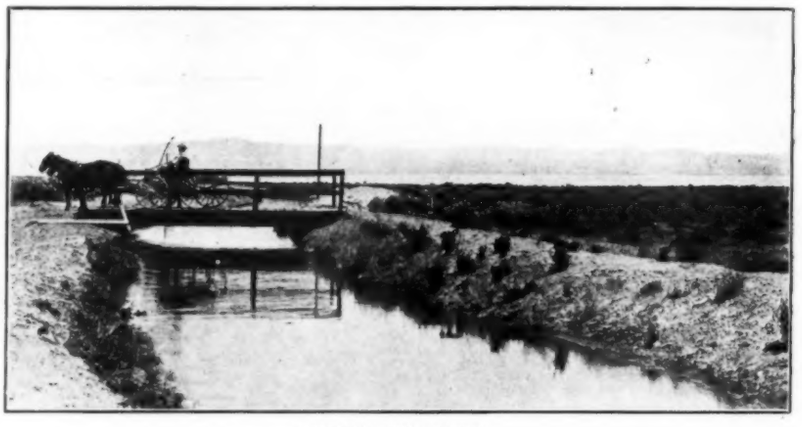
The installation of the hydraulic and electrical apparatus in the power house and pumping station is worthy of special notice in view of the rapidity with which the work was done and the lack of interruption in the service after the units were first put into commercial operation.

As the two stations are located about 80 miles from the nearest railroad and 125 miles from a machine shop, it was necessary for the construction gang to rely wholly upon the tools they could carry with them for installing the apparatus and repairing any damage incurred in transporting the machinery from the railroad.

The apparatus was transferred from the cars to a steamboat at Kennewick, Wash., and carried up the Columbia River to a point as near to the work as could be reached, and was then hauled by mule teams to the pumping station and power plant. The entire hydraulic and electrical apparatus for both stations, including the transmission lines, gates, racks, etc., was supplied and installed by Allis-Chalmers Company, whose engineers designed the plant.

Work on the erection of the power station was begun on March 20, 1908. The installation of the first unit was completed and current was sent over the transmission line on May 23, 1909. The second generating unit was erected during the summer of 1910. In the pumping station, all the apparatus was erected ready for operation in less than a month, work having been started on February 17, and completed on March 15, 1909.

The Hanford Irrigation & Power Company has been succeeded by the American Light & Power Company.



IRRIGATION DITCH.

Electrostatic Voltmeter for Very High Pressures.

A direct-reading electrostatic voltmeter for very high pressures was described by H. Abraham and P. Villard at a meeting of the French Physical Society held on May 5. The instrument has been constructed by Carpentier and is in the form of a cylindrical box about fifteen centimeters in diameter, with rounded corners and carried upon an insulating column. A horizontal rod is suspended in the interior of the box by two steel ribbons in such a manner as to form an articulated parallelogram, thus constituting a pendulum with a motion of translation. This motion is transmitted by means of a connecting rod to an indicating needle and the displacement is read upon a dial through a window. The entire mechanism is placed inside a metal case and is thus perfectly protected from external action.

One of the extremities of the horizontal rod of the pendulum acts as an air damper. The other end is subjected to the electrostatic force. This piece consists of aluminum stamped in the form of a straight rod, with one end enlarged to form a plate, mounted flush with an opening near the middle of the cylindrical case.

The case and the aluminum plate together constitute one of the conductors having a part of its surface movable, on the same principle as that adopted by Lippmann in his absolute electrometer. The movement of the plate is transmitted to the indicating needle. Opposite the moving plate another large plate is found mounted vertically upon an insulating support. According to the distance at which this plate is fixed the apparatus may be given greater or less sensibility. A distance of ten or twenty centimeters can be made to correspond to 100 or 200 kilovolts. For voltages higher than this it is convenient to remove the plate; and the apparatus, reduced to the box and the movable plate, then measures the potential with respect to the ground. This instrument has been calibrated by comparison with the absolute electrometer.

A STUDY OF THE CURRENT TRANSFORMER.—II.

BY P. G. AGNEW.

BEARING ON DESIGN.

While the relation between the slope of the ratio curve and the ratio of variation has been established only for the case of non-inductive load, it may be said that a transformer showing a good performance on non-inductive load will usually give good ratio curves on inductive loads, and *vice versa*, so that while quantitatively the relation will not hold, it will do so in a general qualitative way. Evidently for a given total loss it would be better to select a grade of steel having a relatively high eddy-current and low hysteresis loss, since the former would probably vary almost exactly as the square of the flux at the low densities used. Of course, in this region the eddy-current loss is usually less than the hysteresis loss, but experiments on different kinds of steel might result in finding one whose ratio of variation for the total iron losses would be nearly constant and have a value of approximately 2. It would, of course, be desirable to have such a property coupled with a high permeability so as to keep the phase angle small.

It would also seem to follow that for a given frequency and a given secondary impedance load, the ratio performance might be better in a transformer using relatively thicker sheets, so as to increase the eddy currents, or even by the use of an auxiliary winding to be closed through a resistance. But for general work, where different frequencies and reactance loads are to be used, it would not be advantageous, since the amount of the departure from the ratio of turns would be increased, and hence the change in the ratio resulting from a change in frequency or in impedance load would also be increased, although the curve would be flatter for any given frequency and impedance load.

DISTORTION OF WAVE FORM.

There has been a considerable amount of discussion as to whether wave distortion in a current transformer can introduce appreciable errors in measurements in which the ratio or phase angle of the transformer enters. Of course, in a circuit containing iron there must theoretically be some distortion, however small, and a greatly exaggerated importance has often been assigned to it, but no numerical determinations of the actual magnitude of the distortion have been published.

Two cases are to be distinguished, that of a sinusoidal primary current, and the much more complicated one in which the primary current is not sinusoidal. In neither case, however, can the oscillograph or even the curve-tracer be made to give any but negative results, by merely analyzing the primary and secondary current waves separately. The amount of distortion is so minute that some indirect method must be employed.

The following method was used in the case of a sinusoidal primary current, taken from a star-connected generator whose individual phases have very good waves. Two shunts, R_1 and R_2, were placed in the primary and secondary, respectively, and the value of R_2 adjusted to give the same in-phase drop as I_1R_1 as in the method of getting ratio. (See Fig. 5.) All the distortions present in I_2R_2 will appear in Q. Hence, if we in some way determine the amount of distortion in Q, it will immediately give us the distortion in the secondary current.

From an analysis of such a wave determined by the Rosa curve-tracer, by Thomson's method, the following data are computed for comparison with some of the data derived from the direct measurements of ratio, and of core loss and magnetizing current:

Effective value of 25-cycle component from curve	0.00496 volt.
Effective value of 25-cycle component by dynamometer	0.00487 volt.
Magnetizing current computed from curve	0.511 ampere.
Magnetizing current observed	0.500 ampere.
Percentage of third harmonic in curve	16.00 per cent.
Percentage of fifth harmonic in curve	3.00 per cent.
Percentage of third harmonic in secondary current	0.13 per cent.
Percentage of fifth harmonic in secondary current	0.03 per cent.
Distortion due to third harmonic in terms of effective values	1 part in 1,000,000.
Distortion due to fifth harmonic in terms of effective values	1 part in 20,000,000

A direct analysis of the electromotive force Q was carried out by des Coudres's direct dynamometer method[5], in which the electromotive force to be analyzed is applied to the moving coil of a dynamometer while a current from a machine giving any desired harmonic is passed through the fixed coil. The resulting deflection is due entirely to this particular harmonic. In order to obviate the difficulty of phase relations, the machines were run just out of synchronism, giving a continuous phase shift. The dynamometer would then deflect back and forth, following the continuously changing phase relation, the maximum travel either side of the zero giving a measure of the electromotive force of the harmonic that was being determined.

The amount of distortion in a current transformer is extremely small for a sinusoidal primary wave, the highest figure obtained for any transformer, and that under severe conditions, being but 0.36 per cent of the fundamental, and this adds less than one part in one hundred thousand to the effective value.

In order to determine the distortion for the case of a non-sinusoidal primary wave the method was considerably modified. The results which were obtained at a frequency of thirty-eight cycles are shown in Table III.

TABLE III. DISTORTION IN VOLTS.

Transformer.	Wave form	In phase.	In quadrature.	Total.	Change in effective value.
K	20% dimple	0.00050	0.00017	0.00053	1 in 4000
K	20% peak	0.00021	0.00051	0.00055	1 in 10000
S	20% dimple	0.00077	0.00028	0.00082	1 in 2500
S	20% peak	0.00032	0.00033	0.00046	1 in 6000

We may conclude from the results of these determinations of the magnitudes of the distortion introduced by current transformers, that the distortion is so small that it is of theoretical interest only, amounting as it does to less than one part in one hundred thousand in effective value when the primary current is sinusoidal, and to but one part in twenty-five hundred in the most unfavorable case, and that with twenty per cent of third harmonic in the primary wave. When we consider the good wave forms given by modern alternators, we may safely say that in no practical case can the distortion be detected by its introducing errors into the measurement of either electromotive force, current or power, even with the most accurate instruments available.

It also follows that there is no appreciable difference in the ratio of transformation, whether it be defined as the ratio of the mean effective value of the currents or as the ratio of the primary to the undistorted part of the secondary; and hence there can be no objection against any of the null methods now in use, whether the detector be an electrodynamometer, an electrometer, or a rotating commutator with a direct-current galvanometer.

EFFECT OF WAVE FORM UPON RATIO AND PHASE ANGLE.

While, as we have seen, no appre-

5 des Coudres, *Elektrotechnische Zeitschrift* 21; pp. 752 and 770; 1900.

ciable distortion is introduced by the transformer, the wave form may change the ratio appreciably. This has been pointed out by Rosa and Lloyd[6], who made measurements showing that while small, the effect could be detected.

In Fig. 14 are plotted the results of measurements of the ratio of transformer *J*, which is a high-grade instrument, with five different wave forms, and with two different secondary impedance loads. It should be noted that the vertical scale is greatly magnified so as to separate the curves, also that the impedance load for the upper curves is somewhat severe. The curves are very nearly parallel, and the ratio at the smaller impedance load, even with a wave distorted by twenty per cent of third harmonic, differs only 0.05 per cent either way from the value with a sine curve, while with the large impedance in the secondary the corresponding change is only 0.15 per cent, and these are only half as great with ten-per-cent distortion. The relative accuracy of the measurements was 0.02 per cent.

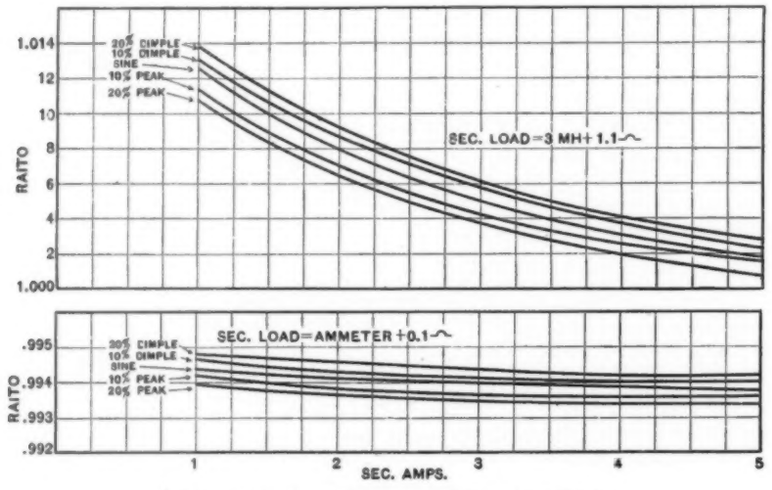


FIG. 14.—EFFECT OF WAVE FORM UPON RATIO.
Transformer J.

The dimpled wave raises the ratio and the peaked wave lowers it, which is in the direction that theory would predict, since a dimpled wave increases the iron losses and a peaked wave decreases them for the same effective value of electromotive force, as has been shown by Lloyd[7] and others.

The effect of wave form on the phase angle is very small. For example, with twenty-five cycles, 1.1 ohm resistance in the secondary circuit, full-load current, it amounted to less than two minutes when the wave was distorted by twenty per cent of third harmonic, either peak or dimple.

The effect of wave form upon ratio and phase angle is very similar to that of small changes in frequency, as might be expected, and with good transformers is entirely negligible with the wave forms met with in practice.[8]

6 *Bulletin of the Bureau of Standards*, 6, p. 30; 1909.

7 *Bulletin of the Bureau of Standards*, 5, p. 381, 1909; Reprint No. 106.

8 A more detailed account of the work, together with a bibliography of the current transformer, will appear shortly in the *Bulletin of the Bureau of Standards*, Vol. 7, No. 3; Reprint No. 164.

Electricity on the Titanic.

A description of the electrical equipment of the White Star liner recently published in the *Electrical Review* of London gives a number of interesting figures on the installation on that boat.

The plant consists of four 400-kilowatt sets installed in a separate watertight compartment aft of the main engine room at tank-top level. The engines, which each indicate about 580-horsepower, are of the Allan three-crank type, running at 325 revolutions per minute. These exhaust either into a surface heater or to the condenser. Each engine is direct-coupled to a compound-wound continuous-current 100-volt generator so that their collective capacity is 16,000 amperes. The generators are fitted with interpoles. In addition to the four main generating sets there are two thirty-kilowatt engines and dynamos, placed in a recess off the turbine-room at saloon-deck level. These sets can be supplied with steam from either of several boiler rooms, and will be available for emergency purposes; they are similar to the main sets, but the engines are of the two-crank type. The distribution of current is controlled and metered at a main switchboard placed on a gallery in the electric engine-room, to which the main cables and feeders are connected. The latter pass up through port and starboard cable trunks to the various decks, radiating from thence to master switch and fuse-boxes grouped at convenient points in the machinery spaces and accommodation, from whence run branches to the distribution fuse boxes scattered throughout the vessel, controlling the lamps and motors. A complete system of electric lighting is provided, and electricity is also largely employed for heating, as well as for motive power, including no fewer than seventy-five motor-driven Sirocco fans of from fifty-five inches to twenty inches in diameter, for ventilating all the passenger and crew spaces, as well as the engine and boiler-rooms.

A Profitable Electric Property in Siam.

An American consul at Bangkok, Siam, states that, although in general the business of the year 1910 was considered poor, the Siam Electricity Company, Limited, which owns the only large electric light plant in Bangkok, also the street-car lines, paid the usual dividend of twelve per cent and a bonus of $2.22 per share of $50, on 25,000 shares. It is said that the Siamese Government has decided to install its own electric power plant for the water-supply system, and also intends to provide electricity for lighting the palaces, parks and districts adjacent to the pumping station. The electrical company now supplies the current for this lighting, and if the Government should take over this work the company will sustain considerable loss of revenue.

New Patent Law in Germany.

On July 1, a law amending the former patent law of Germany went into effect. It provides that, after three years from the granting of a patent, it may be revoked if the invention be worked exclusively or mainly outside the German Empire. Should a patentee refuse permission to an applicant to use the invention for reasonable compensation, the right to use the invention may be given to the applicant. This right may be in a limited form and dependent upon conditions.

Hydroelectric State Power Station in Sweden.

The Swedish State, to begin with, exercised a wise caution in the matter of hydroelectric stations of its own, leaving it to private initiative to do what may be called the pioneering work; but now that the technical problems seem to have been satisfactorily solved, the Government is going ahead with laudable energy. The Alfkarleby power station is likely to follow promptly in the wake of the two large stations already constructed. Preparatory work in connection with the exploitation of the Alfkarleby Falls has been going on for several years. In the year 1904 Major Gagner was commissioned by the Government to prepare a plan, which was completed in 1907, but it was not adopted, and in the beginning of 1908 the Trollhattan Canal & Water Works Company was instructed to prepare plans for a State power station at the said falls. The following year the task was transferred to the newly formed Waterfalls Board, which department has now handed in its proposal to the Government.

The Alfkarleby Falls, the last of the Dala River falls, situated about five miles from the mouth of the river, are now divided by two islands, the Flakon and the Laxon, into three falls. The aggregate height of fall at Alfkarleby is, with low water, about fifteen meters. Beneath these falls the river flows comparatively smoothly, but within the two and one-half miles section above the falls there are the Stallfors Fall, about 1.75 meters high, the Nygardsfors Fall, about 1.5 meters high, and above the latter the Lanfors Fall, about 8.7 meters high. Of these falls, the State owns the eastern shore of the Nygardsfors Fall, the remainder belonging to the companies.

In planning the exploitation of the Alfkarleby Falls it has been found that material advantages could be obtained by also exploiting the head of the two nearest falls, the Stallfors and the Nygardsfors. The damming of these two small falls entails, amongst other advantages, that of making the basin between Alfkarleby and the Lanfors Fall available as a convenient reservoir for variable demands at the different periods during the twenty-four hours. The damming of the two small falls will further materially reduce the ice trouble, to which such shallow falls are subject. To utilize the fall of the river between the Alfkarleby Falls and the sea is, at the present time at least, considered out of the question.

In order to realize the highest financial result it is proposed to dispose of part of the power under guarantee of continuous delivery, and part subject to a cessation during the time of the year when the supply of water is low. The consumers of power will consequently have to be divided into two classes. The station at Alfkarleby ought, therefore, in the opinion of the Waterfalls Board, to be planned for a minimum consumption of 200 cubic meters of water per second, in addition to which comes a variable withdrawal during the twenty-four hours of fifty cubic meters per second, or 250 cubic meters per second all told.

The scheme comprises the construction of a dam across the three branches of the river just above the Alfkarleby Falls. From the reservoir formed above this dam the water is to be led through an inlet canal, about 250 meters long, to the power station, which is to be located on the right shore. Below the power station a short outlet canal is to be constructed into the river. In connection with a bridge across the upper end of the inlet canal there will be an intake with sluices of the Stoney type.

The power station, in the first stage, is intended to be built with a capacity of 18,000 turbine horsepower, plus reserve, and with the possibility of being extended to a capacity of 45,000 horsepower, plus reserve. The cost is calculated at 8,270,000 kroner, or about $2,250,000. The second stage, with a capacity of 27,000 turbine horsepower plus reserve, will entail an additional outlay of about $140,000, and the third stage will further swell the cost by some $110,000, making a total of about $2,500,000.

It has already been pointed out that the Alfkarleby Falls boast an exceptionally convenient location, Stockholm, for instance, lying within the 150-kilometer circle.

Considering the claims agriculture is likely to make upon electrical energy in a not very remote future, and the satisfactory results recent electric iron-ore smelting has yielded in Sweden, there is reason to believe that the full capacity of the Alfkarleby station will be promptly needed.

With regard to the financial results, the power station, in its first stage, is expected to pay its own working expenses and interest on the capital sunk in it, but hardly any interest on the capital represented by the water power itself. Such return, however, may be fully reckoned upon when the capacity of the station is extended. The regulation of Lake Siljan is under contemplation, a plan with this end in view being at present under consideration by the Waterfalls Board. This scheme will further increase the capacity of the Alfkarleby and other falls.

Electric Control by Wireless.

News of some remarkable experiments with wireless electricity comes from Nuremburg. The operator and inventor is a local science teacher, Christopher Wirth. His first experiments took place in a building where the inventor went into a room surrounded by thick walls, and passed electric waves through the wall, exploding miniature mines on the other side in the order selected by his visitors. He also fired off a revolver and started and stopped an electric motor and a steam engine by the same means. The demonstrations were performed in the presence of a special Committee of the German Navy League, who afterwards accompanied Herr Wirth to the Wannsee Lake, near Berlin, where he navigated a specially made boat from the land, steering it in all directions without visible connection, fired off guns which were on board, and exploded sunken and floating mines in the water. The unmanned motor-boat was then steered through a labyrinth of small boats, the gear was reversed, and she returned to her original position. Bengal lights and fireworks were also ignited by wireless waves and only in the order desired. The wave currents were transmitted and received through antennae in a very similar manner to that used in connection with receivers and transmitters in wireless telegraphy. The inventor has also applied his apparatus to balloons and flying machines. Thus an aeroplane with electric motor can be steered from land in all directions and can be made to drop bombs when required. A somewhat similar invention was recently reported from New York, where Mark Anthony, a well known electrical engineer, offered his device to the United States Government for $125,000. The offer was declined, and it is now under the consideration of the French Government.—*Electrical Engineer.*

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION.

ELEVENTH ANNUAL MEETING HELD AT NIAGARA FALLS, N. Y., JULY 18-22.

The eleventh annual convention of the National Electrical Contractors' Association was held at Niagara Falls, New York, July 19, 20 and 21. This was without doubt the most successful convention the contractors have ever held. Not that there was in attendance an overwhelming percentage of the membership, but because of the fine spirit of fraternity and co-operation that was manifested between the contractors, manufacturers and jobbers gathered together. It was a notable convention also for the establishment of more satisfactory relations on the part of the manufacturer and the contractor. The closed sessions were devoted to discussions of important matters affecting the business of the contractor and the discussion of these vital matters reached into and became an important and interesting part of the open sessions.

The first session was called to order by President Marshall L. Barnes in the International Hotel on Wednesday morning, July 19. Mr. Barnes said that he was grateful indeed to note the large attendance of contractors, manufacturers and jobbers, and hoped that this convention would set a new mark with respect to establishing a closer community of interest between the several elements which should work together in order that there might be a maximum of prosperity for all.

As noted in the last issue of the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN, the first session was devoted to the presentation of papers as follows: "Credit Protection," by Franz Neilson, New York City. This paper was read by James R. Strong. "Proper Lamp for the Circuit," by P. F. Bauder, Cleveland, Ohio. This paper was read by R. E. Campbell.

The paper entitled "Co-Operation in the Electrical Industry" was presented by the author, Philip S. Dodd. Mr. Dodd called attention to several notable examples of co-operation which were now being worked out in the electrical industry and emphasized the necessity of the mutual working together of the central-station man and the contractor. Mr. Dodd explained the advantages of advertising electrical apparatus and installation details in the local dailies and endorsed the idea of an "electrical page," where all of the electrical advertising might be grouped and this advertising supplemented by reading matter which would further explain the advantages of using electrical apparatus. Quite recently the Department of Publicity of the National Electric Lamp Association has been directing a campaign in sixty-two of the principal cities in this country, offering to supply the proper reading matter and in this way working up an active interest between the central station and the local daily in each of these cities. A correspondence course projected by the Shelby Electric Company, of Shelby, Ohio, consisting of a course in practical illumination of twelve lessons, four on show-window illumination and eight on store illumination, was described. The Shelby Company is also assisting the contractor to develop the lamp business by carrying on a forty-weeks' campaign of advertising direct to the lamp buyer.

On July 20 there was an open session at 10:00 o'clock at the International Hotel. The first speaker was F. E. Cabot, secretary of the National Fire Protection Association, Boston, Mass. Mr. Cabot made a very interesting address and appealed to the contractors to assist the National Fire Protection Association in every way they could, not only in installing their electrical equipment so as to minimize the fire risk, but to carry this idea into their homes and do as much as they could, as good citizens, to minimize the fire waste. Mr. Cabot sketched very briefly the development of the idea of fire protection and the establishment of the National Electrical Code, paying a tribute to the great work which had been done by C. M. Goddard in this connection. The annual fire waste in this country amounts to between two hundred and two hundred and fifty billions of dollars, and while the hazards have been greatly improved there is still a great deal to do. So far as the electrical fire hazard is concerned, however, it is his opinion that this did not amount to more than $50,000 a year, an almost negligible quantity when considering the entire fire waste. The small loss occasioned through electrical fires was due to the control which was exerted through the National Electrical Code. Mr. Cabot considered that this was one of the most powerful codes in existence because it was universally obeyed.

E. H. McCleary, of Detroit, emphasized the importance of the statement made by Mr. Cabot respecting the amount of fire loss occasioned by electrical fires, and asked permission of Mr. Cabot to use this statement quite uni-

GROUP AT ELEVENTH ANNUAL MEETING OF THE NATIONAL

versally. Mr. Cabot in replying said that he would be very glad to make a formal statement substantiating his figures in this case and said that he thought a closer inspection of the absolute figures would reveal a much lower loss than he had indicated.

A paper entitled "The Contractor as a Merchant" was read by C. E. Whitehorne, of New York City. Mr. Whitehorne made a very interesting analysis of the present conditions of merchandising so far as the electrical contractor was concerned, and warmly advocated the establishment of electrical stores where complete lines of electrical supplies and fittings might be established and high-grade salesmen be in charge to look after the wants of the customer.

In the discussion that followed the reading of this paper there was a good deal of difference of opinion manifested with regard to the advisability of the contractor laying in an expensive supply of shelf material. It had been the experience of some that the carrying of supplies was a very necessary and important adjunct to the contracting business, as it influenced a good deal of extra business. The experience of others, however, had been unfortunate and it seemed to be the opinion of most of those who entered into the discussion that there was not now a sufficient margin of profit in the resale of electrical material for the contractor to devote much of his energy or capital to the establishment of salesrooms.

The morning session was closed by the reading of a very interesting paper entitled "Relations Between the Central Station and the Contractor." This paper was prepared by Arthur Williams, of the Edison Company of New York, and was presented by A. A. Pope.

The meeting of the directors of the National Electrical Contractors' Association was held at the International Hotel on July 18, and on Wednesday and Thursday following there were closed sessions for the members. At the Thursday afternoon session the following offieers were elected:

President, M. L. Barnes, Troy, N. Y.

First Vice-President, Ernest Freeman, Chicago, Ill.

Second Vice-President, H. S. Potter, Boston, Mass.

Third Vice-President, J. C. Hatzel, New York, N. Y.

Treasurer, John R. Galloway, Washington, D. C.

Secretary, W. H. Morton, Utica, N. Y.

Sergeant-at-Arms, J. C. Sterns, Buffalo, N. Y.

The entertainment features were of a most delightful and varied character, and were thoroughly enjoyed by everyone. On Wednesday the ladies and guests of the Association left the International Hotel at 3:00 p. m. in automobiles for a long trip around the country surrounding the beautiful Niagara Falls, in the custody of Emmet Flemming and O. W. Cutler. On Wednesday evening there was a reception and dance at 9:00 o'clock, with Mr. and Mrs. M. L. Barnes and Mr. and Mrs. P. N. Thorpe in charge.

At 10:30 o'clock Wednesday evening there was a Rejuvenation of the Sons of Jove in charge of Statesman A. E. Brock. A class of twenty-seven initiates were put through the ceremonial. Without doubt this was one of the most enjoyable and well-executed rejuvenations that has been held for some time. The team work was very smooth, Robert L. Jaynes, of Pittsburg, making an austere and imposing Jupiter, while Thomas H. Bibber carried off the forensic honors as Pluto. At the Joviation which followed a number of informal addresses were made and the party did not break up until the early hours of the morning.

On Thursday evening there was a dinner for the ladies, guests and members at the International Hotel, followed by a very enjoyable vaudeville performance. The committee in charge included E. D. McCarthy, E. P. McCormick, C. F. Sterns and E. W. Mullett.

On Thursday afternoon a great many of those in attendance visited the plant of the United States Light & Heating Company, at Niagara Falls, where the "National" storage batteries are made. The company's fine plant was thrown open for inspection and every detail of manufacture was explained to those visiting. The party was conveyed from the International Hotel to the works and back again in powerful commercial trucks, the motive power being furnished by "National" batteries, and were provided with refreshments and cigars and cigarettes at all stages of the visit. The reception party included W. L. Bliss, chief engineer; W. P. Hawley, A. H. Ackerman, A. O. Heister, and Alexander Russell.

Friday, July 21, was devoted to visits to the New York power house of the Niagara Falls Power Company, a trip over the Gorge Route of the Niagara Falls Railway, and a baseball game at the Catholic College grounds of Niagara University. The baseball game was highly enjoyable and the Western team were victors by a score of nine to six.

ELECTRICAL CONTRACTORS' ASSOCIATION, NIAGARA FALLS, N. Y.

ALTERNATING CURENT VERSUS DIRECT CURENT FOR USE ON BOARD SHIP.[1]

BY S. M. ROBINSON.[2]

At first sight it would seem that the advantages of alternating current disappear on board ship, since the main advantage—that of more economical power transmission for long distances—does not hold here. However, the electrical installation of a battleship is such a complicated problem that it finds no parallel elsewhere, and it has to be considered in detail to determine which system is the better. In order to do this it will be necessary to enumerate the electrical appliances used on board ship, and also to consider the wiring of the ship.

The following list comprises most of the electrical appliances to be found on one of our new battleships:

Four 300-kilowatt generating sets.

Two 500-watt motor-generator sets for interior communication; voltage 16 to 20.

Two 500-watt motor-generator sets for telephones; voltage 16 to 20.

Two 25-watt dynamo-motors for telephone bells; voltage 75, frequency $16\frac{2}{3}$.

Two 1.5-kilowatt motor-generator sets for turret danger-zone signals; voltage 125, frequency 60.

Two small motor-generator sets for turret tell-tale system; voltage 20.

One small motor or motor-generator set for the howlers.

One 5-kilowatt motor-generator set for wireless telegraphy; voltage 110, frequency 500.

Numerous one-quarter-horsepower ventilating sets.

Four 5-horsepower jacking motors for turbine ships.

Twelve 45-horsepower motors for forced-draft blowers.

Eight motors for machine shop, ranging from 0.75 to 7.5 horsepower.

The time-firing device.

Twelve 40-horsepower motors for the turret ammunition hoists.

Twelve 3.5-horsepower motors for breech closing.

Twelve 10-horsepower motors for the rammers.

One 12-horsepower motor for the sanitary pump.

Six small motors for use in the galley, ranging from 0.25 to 2 horsepower.

Two 3-horsepower motors for fresh-water pumps.

Fan motors for the ventilating system, ranging from 1.75 to 11 horsepower.

Two 40-horsepower motors for hoisting for the boat cranes.

Two 30-horsepower motors for turning for the boat cranes.

Seven 35-horsepower motors for deck winches.

Four 4-horsepower motors for fire-room elevators.

Seventeen three-quarter-horsepower motors for the long-arm system.

One 6-horsepower motor for the laundry.

Fourteen 3-horsepower motors for the chain hoists.

Four 4-horsepower motors for the ammunition conveyors.

Twelve 35-horsepower motors for turret turning.

Twelve 15-horsepower motors for gun elevating.

Electric ranges of 190 and 380 horsepower.

Electric bake oven of 20 horsepower.

Searchlights taking 120 amperes at about 50 volts.

Incandescent lamps.

The motors of the ship can be roughly divided into four classes:

(1) Those not requiring large starting torque, nor variable speed, but requiring good speed regulation with change of load. These are the motor-generator sets, fan motors, portable ventilating sets, time-firing-device motor, small motors in the galley, laundry motor, turret-training and gun-elevating motors when equipped with Waterbury Tool Company's method of speed control.

(2) Those requiring considerable starting torque, but not requiring variable speed. These are the pump motors, motors for the long-arm system, chain-hoist motors, ammunition-conveyor motors, and turret ammunition-hoist motors when arranged to run continuously, as they are on the new ships.

(3) Those requiring considerable starting torque and a speed falling off considerably with increase of load. These are the deck-winch motors and elevator motors.

(4) Those requiring a variable speed, either large or small starting torque, and reversibility. These are the machine-shop motors, hoisting and turning motors for the boat crane, rammer motors, forced-draft blower motors, and jacking motors.

Let us take up this list in detail to see whether alternating current is suitable. The generators would be of the three-phase type, giving 125 volts as at present, and sixty cycles frequency. This frequency would be suitable for both motors and lights. The three-phase system would be used in preference to other polyphase systems, as it gives a simpler wiring arrangement; the single-phase system is not flexible enough and is not adapted for all motors.

In a three-phase, sixty-cycle, alternating-current system the motor, to fulfill the requirements of the four classes of motors used on board ship, would be the induction motor in some form.

The different forms of this motor adapted for the four classes of service required on board ship would be:

(1) For class one, a squirrel-cage motor with a very low-resistance rotor; it would have small starting torque, small slip and high efficiency.

(2) For class two, a squirrel-cage motor with a higher resistance in the rotor windings; it would have a fairly large starting torque, variation of speed with load would not be considerable, and the efficiency would be fairly good.

(3) For class three, a squirrel-cage motor with a high-resistance rotor; it would have very large starting torque, large slip, great drop in speed with increase of load, and low efficiency.

(4) For class four, a definite wound rotor, with variable resistance in the armature; it could be arranged to give maximum torque at starting; the slip and efficiency would depend on the amount of the resistance used.

Each of these motors would perform its duty in a perfectly satisfactory manner in every way. Those with high-resistance rotors would be inefficient electrically, but they are only used intermittently, and, for that matter, the direct-current motors used for the same purpose would, as a rule, be inefficient. The actual performance of the work would be entirely satisfactory and most of the motors highly efficient.

There is another form of alternating-current motor which would be useful for some purposes on board ship. It is a recent modification of the single-phase series motor. It has a stationary armature and commutator, which are just like those of a direct-current machine

1 Abstracted from *Proceedings of the United States Naval Institute*, June, 1911.
2 Lieutenant, United States Navy.

in their relation to each other, but the commutator is separate from the armature and may be situated any distance from it. The brushes on the commutator are supplied with single-phase alternating current and they are revolved, either by hand or by a small motor, thus producing a revolving and pulsating field in the armature. The rotor consists of a drum with one short-circuited coil on it. This coil keeps step with the brushes as they revolve. The action of the motor is practically the same as that of a transformer, so that when the brushes are stopped the current supplied to them will be very small, being only the magnetizing current. The amount of torque developed at starting will vary with the load; the speed will be independent of the speed of the generator and will depend solely on the speed of the brushes. The efficiency is slightly lower than that of polyphase motors and the power-factor is higher.

This motor would be very suitable for a steering engine, since it has the advantage that when the brushes stop rotating the motor becomes a generator, giving a very powerful braking action that is obtained in direct-current machines only at the expense of considerable complications.

For turret work it would be an ideal form of motor, as it would be equivalent to hand training and elevating without any of the disadvantages of the latter. It would also have the advantage that it could be operated by direct current from storage batteries if these were installed in the turrets for an auxiliary power supply. If used in this way there would be two coils on the rotor, and the second one would be short-circuited only when using direct current. The storage batteries would be charged from the power circuit through a mercury-arc rectifier.

This motor could be used on three-phase mains without any difficulty.

Next consider the wiring of the ship. There are the power and light mains with the branches tapped off from them. The following smaller lines are also energized by generator voltage:

General-alarm gongs.
Cease-firing gongs.
Helm angle indicator.
Steering telegraph.
Engine-revolution telegraphs.
Steering emergency signal.
Course indicator.
Ammunition-hoist indicator.
Electric-whistle operator.
Anchor handling and boat hour gongs.
Range and deflection instruments.
Spotters' information circuit.
Sub-operators' information circuit.
Bells and buzzers for salvo firing.
Gyro indicators.
Torpedo-firing circuit.
Water-tight door signals.
Howlers.

The following lines are energized by motor-generators:

Interior communication motor-generators.
Call bells for voice tubes and state-rooms.
Fuel-oil tank indicators.
Fire-alarm system.
Fire-room and engine-room telephone call bells.
Magazine temperature indicators.
Refrigerator-room temperature indicators.

Telephone motor-generators.
Telephone circuits.
Ship's telephones.
Fire-control telephones.
Maneuvering circuit.
Fire-room and engine-room circuit.

Special motor-generators.
Turret danger-zone circuit.
Turret-tell-tale circuit.
Gun-firing and sight-lighting circuit.
Gyro-compass circuit.

Shafts furnish power.
Shaft-revolution-indicator circuit.

As arranged on the new ships, these circuits all lead to a central switchboard.

For all these circuits except one alternating current is suitable; in a number of cases it is necessary and is already in use, as shown by some of the motor-generator sets. For the telephone circuit alternating current is not suitable, and a motor-generator supplying direct current could be used as at present. A better plan, however, would be to use duplicate storage batteries, using these alternately, and charging them by means of a mercury-arc rectifier; a battery is more suitable for telephone work as it has no scratching of brushes or hammering noises to transmit to the telephone.

For the wireless sets, a frequency changer would have to be used, for, although alternating current is used for this work, the commercial frequency of sixty is found to be not so efficient as a frequency of 500.

For the searchlights, alternating current would be used, but it would be transformed to the proper voltage instead of using a very large and wasteful rheostat, as is done at present; a constant-current transformer would be used for this purpose.

The lighting circuit of the ship would be wired as a single-phase circuit.

In looking over the ship's complete installation, it will be noticed that a great variety of voltages exist, requiring a great number of motor-generators; also that alternating current is at present used in a number of cases; and also that, on account of the desirability of suitably locating the motor-generators, it becomes necessary to make all circuits extend practically throughout the ship. If alternating current were substituted, all these motor-generators could be replaced by transformers, which, on account of their small size and reliability, could be placed wherever it is necessary to run a circuit. Thus many of the circuits could be localized, doing away with much wiring; also, if it should become desirable to add new circuits, this could be done very readily and without installing motor-generator sets. The first cost and cost of upkeep would be reduced and the care necessary for maintenance would be much less; by removing a great many of the small circuits a fruitful source of grounds would also be removed.

The generators themselves would be simpler and cheaper machines if of the alternating type; they would also be especially suited to the turbine drive and less liable to most troubles generally than the direct-current generator.

In the case of the motors, the advantage is still more pronounced; while having an efficiency equal to or better than a direct-current motor, the induction motor is more compact, requires much less attention, costs less for maintenance, and is far less liable to break down.

Some minor advantages of alternating current are: less trouble with switches on account of arcing and burning, non-magnetic leads, less corrosive effect, more reliable circuit-breakers, and less danger of installation breakdowns resulting from circuit-breaker operation.

To sum up the advantages of the alternating-current system, it seems to be cheaper, simpler, more reliable and to require less care and attention.

CENTRAL-STATION PRACTICE

Transmission—Interior Wiring

ELEMENTS OF POWER-STATION DESIGN.—XXXVI.

ORGANIZATION AND FINANCE.

BY W. B. GUMP.

The organization and management of a power enterprise is the very foundation of its success or its failure as a financial undertaking, assuming at the start that the power market is not lacking in any of the essential factors which, when taken collectively, justify the investment in the property.

Too often the management is short-sighted to the extent that the plant (or system of plants) is slighted in the beginning, or after its operation begins, the organization in direct charge being composed largely of cheap and incompetent help. In the majority of cases it will be found that where one of these conditions exists, the other naturally accompanies it; in other words, a project which is carried on cheaply and poorly in the start is apt to continue the same policy until the personnel is entirely changed and a new management takes hold of the property.

The engineering fraternity at large has a keen appreciation of engineering efficiency, but it is a difficult task to inculcate this feeling in the mind of the layman. On every hand the executive heads of large factory organizations, and power systems as well, are using their efforts in every possible channel, except the correct one, to keep down the cost of operation.

It is clear then that the most flagrant faults of the average non-technical manager are:

(1) The installation of inefficient and unappropriate apparatus.

(2) The employment of cheap and incompetent labor.

These factors are quite common in manufacturing establishments. One of the chief causes is due to the fact that the selection of machinery for the generation of power is left largely to the factory superintendent, who, though a good organizer of labor, is seldom, if ever, equipped as a power-plant economist. In the majority of cases of this kind the general manager finally passes upon the machinery, incorporating some of his own ideas in the way of an installation which is cheap as to first cost, and inevitably most expensive in cost of operation. To begin with, there is the lamentable fact that the machinery salesman has prevailed upon the manager, selling him a plant equipment which may, or may not, be best adapted to the operating conditions in hand, and, when there are no absolute guarantees as to fuel economy, the responsibility of the machinery house is ended as soon as the machinery has been delivered and erected.

The importance of a well organized system of management cannot be overestimated. In order to bring this about, it must be conceded that first-class employees are necessary. While high-class help means a high pay roll, it also means economy in the total cost of operation, provided the organization is not out of proportion to the demands of the enterprise. This works both ways; that is, a very poor or a very elaborate organization will increase the cost of a given sized undertaking. The problem, therefore, is to ascertain how far we can go in order to reach the maximum commercial efficiency and hence the minimum total cost of operation.

In considering the economics of a power enterprise it will be convenient to compare both steam and hydroelectric properties, treating them with respect to their individual items, such as:

(1) Rated output.
(2) Load-factor.
(3) Investment.
(4) Fixed charges.
(5) Operating cost.
(6) Depreciation.
(7) Obsolescence.

The rated output designated as item (1) is understood to mean the normal kilowatt rating of the plant or group of plants considered. It is evident that the rated output of station equipment should be definitely related to the station load-factor. When considering a single plant, we usually find at its inception that the initial load is quite uncertain, and the first installation is dependent upon probable rather than actual loading. The term "load-factor" as used in the present case will be understood to mean the station load-factor, or the average daily kilowatt load for twenty-four hours divided by the rated capacity of the station.

The initial investment should necessarily provide for immediate extensions without altering the original building. Under these conditions (those of a single station just beginning its career) the cost per unit of rated output is likely to be comparatively high, while in a large power system having a number of plants the investment per unit of station output may be small when considered as a whole. Again, the load-factor must be taken into account. However, the latter case as a rule presents (or is capable of presenting) a better load-factor than a single plant; particularly a lighting plant with practically no power load.

Let us consider first, in a general way, the investment costs with reference to water power. The usual water-power opportunity involves a heavy initial investment per unit of rated output as compared to steam power, assuming that the steam plant is located at the point of utilization. This fact was pointed out in the first chapter in which the relative average costs were referred to.

Reverting to the first comparison made, we see that the most attractive feature of water-power development is the absence of the fuel item. This item is the most expensive one in connection with steam-plant operation, as will be seen later.

Nevertheless, the interest charge on the capital invested in a hydraulic development will in many cases offset the advantage of eliminating the fuel item, and will show the practicability of steam

power in a striking manner; not infrequently to the sorrow of those advocating hydroelectric power.

The fixed charges as ordinarily considered include the items which do not vary with the output, but are constant. These items are:

(1) Investment costs.

(2) Administration charges.

The first comprises interest on the invested capital, taxes, insurance, depreciation of the equipment, and a reserve fund covering amortization.

The administration charges embrace the rental of offices, the salaries of officers of the organization and like overhead expenses.

The operating cost is made up of

(1) Salaries of employees.

(2) Cost of fuel (except in hydraulic plants).

(3) Cost of supplies.

(4) Cost of repairs.

The effect of the load-factor on the cost of power may be seen from the accompanying curve, which is reproduced with due courtesy to Prof. G. F. Gebhardt's book on "Steam Power Plant Engineering." Here it will be seen that the total fixed charges take the form of a straight horizontal line, while the operating costs per unit output decrease as the load-factor increases.

Depreciation has been given as a separate item, but is, of course, included in the investment costs. It is a factor of such great importance that a discussion of it is believed to be justified. Depreciation is generally understood to mean the rate of decrease in value of an equipment. When reckoned on this basis, the rate of depreciation due to wear and tear is a fixed percentage per annum of the original cost. For example: if the useful life of a steam engine is twenty years, the depreciation is five per cent. Strictly speaking, the same engine may be made to operate for thirty years, and on this basis the depreciation would be three and one-third per cent. However, if we consider that at the end of twenty years the engine has only scrap value, and should be replaced by new apparatus, the actual depreciation would be five per cent of the sum which is made up of the original cost of the engine installed, less the scrap value. This difference is known as the wearing value.

If we look at depreciation from the point of view of the owner and capitalist, it is customary to set aside a certain sum each year, which, if allowed to draw interest, will, in a fixed number of years, equal the cost of replacing the apparatus so depreciated. The sum so laid by is termed a sinking fund or amortization fund, and it usually is reckoned at compound interest.

The equation expressing depreciation in terms of useful life and rate of interest was given in a former chapter but may be repeated here:

in which

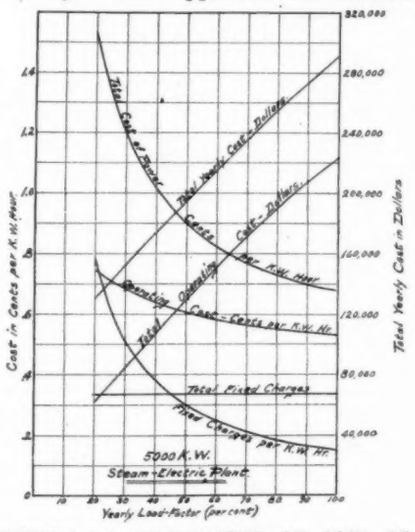
$$D = \frac{100\,r}{(1+r)^n - 1}$$

D = rate of depreciation in per cent of first cost,

r = rate of interest,

n = assumed life of apparatus.

This formula is based upon interest which is compounded annually, and also upon the assumption that at the end of n years the apparatus has reached


Total Cost of Power
Total Yearly Cost - Dollars
Fixed Charges Cost - Dollars per K.W. Hour
Operating Charges
Total Cost - Cents per K.W. Hr.
Total Fixed Charges
Fixed Charges per K.W. Hr.
5000 K.W.
Steam-Electric Plant
Cost in Cents per K.W. Hour
Total Yearly Cost in Dollars
Yearly Load-Factor (per cent)

EFFECT OF LOAD-FACTOR ON COST OF POWER.

zero in value. It is evident, therefore, that under other conditions the equation must be modified.

The item known as obsolescence refers to the state of machinery which is superseded by an improved type, making the original machinery obsolete as far as efficiency is concerned. An example of obsolesence is seen in the case of reciprocating-engine plants which have improved their efficiency by the adoption of steam turbines, the engines becoming obsolete.

The organization of a power enterprise evidently has its beginning in the original development of the property. The financiers and promoters generally form the nucleus of the subsequent organization as a power company, directing the operation and management of the system. The importance of a first-class system of accounting cannot be overestimated. Too often this part of the administration is weak, and in many systems the true cost of power is not known within 100 per cent. This fact seems to be due to lack of knowledge of all of the factors to be included in computing power costs, and not infrequently to negligence or carelessness in considering these items.

It cannot be disputed that those directly connected with the management should be qualified technically as well as commercially.

It may be stated here, that the engineer of today is called upon to combine business with his engineering, and he is, therefore, better able to grasp the business end than the business man to comprehend the technical side. The engineer will, therefore, appreciate the opportunities to reduce the cost of operation to a greater degree than is generally shown by the non-technical business man. It is not out of place to call attention to the fact that commerce controls engineering. This is the most important reason why the engineer of today should be a thorough commercial man. Armed with a combination of both the technical and the commercial, he is able to meet the situation far better than he could hope to do by depending upon either one of these qualifications.

COMPARISON OF STEAM AND HYDRAULIC PLANTS.

Let us now compare the financial program of a given hydroelectric development with that of a steam plant of similar rating. We may safely assume that the first cost per kilowatt of hydroelectric power will generally range between $100 and $300. These figures refer to the cost per kilowatt of rated output delivered to the switchboard within the plant. The higher figure ($300) is unusual, and not a few cases arise where the cost runs below the first figure.

For convenience, we shall consider a plant of 10,000 kilowatts rated capacity. For the hydroelectric plant it will be fair to assume a first cost of $120 per kilowatt. Allowing ten per cent loss in transmission, including losses in transforming apparatus, we have 9,000 kilowatts available at the point of delivery. The corresponding steam plant will, therefore, also be considered to have 9,000 kilowatts maximum capacity. We shall assume a yearly load-factor of forty per cent. This is fairly high but

is consistent with a plant of the capacity named, if such a plant supplies a fairly large percentage of power in proportion to its lighting load. A plant of this nature would not likely be reliable the year round without a relay plant, preferably steam, which must be included in the investment.

It will be remembered that the working capacity of a hydroelectric plant must equal the peak load, while a steam plant may be rated to take only the average, and accommodate the peak by means of its reserve in the shape of overload capacity. If both the steam and the hydraulic plant are reckoned on exactly the same basis, the capacity required is necessarily measured by the maximum or peak load. Since the kilowatt rating of the steam plant, however, is ordinarily based on the average load, a more compact layout is secured than would otherwise be the case. This situation necessarily favors the steam plant, and tends to decrease both the first cost and operating expenses.

From the assumption given the rating of the hydraulic plant is based on a station capacity of 10,000 kilowatts at the generating end, and 9,000 kilowatts at the receiving end or substation. The steam plant (assuming that steam turbines are installed) will have a normal rating of 7,500 kilowatts, with a continuous overload of twenty per cent. A steam-turbine plant of this capacity should not exceed $100 per kilowatt of rated capacity. Comparing now the first costs we see that the hydroelectric generating plant will cost $1,200,000 to install, while a steam turbine plant of the same output costs $750,000 complete, or only five eighths that of the hydraulic plant.

Considering a single generating station in either case, we find that the steam plant may distribute directly to the consumers, while the hydroelectric plant must operate through a substation. It is, therefore, entirely proper to charge the hydraulic plant with the cost of transmission lines and substation, as these virtually become a part of the generating plant.

If the hydraulic plant requires a relay steam plant, its cost should be included in the cost of the hydroelectric property. Let us suppose in this case that the minimum flow provides for 4,000 kilowatts. With a station load-factor of forty per cent, the average load at the consumers' end is 3,600 kilowatts. The auxiliary steam plant would require a capacity of 3,000 kilowatts rating with, say, a guaranteed overload capacity of fifty per cent.

Let us assume that the distance between the hydroelectric plant and its substation is fifty miles. This demands a transmission line costing not less than $150,000. This portion of the investment will necessarily be included, and its cost, interest, and depreciation must be duly taken into account.

It seems necessary here to mention the fact that the usual scheme of development program falls short of making the proper allowance for the financial burden. Some of the items not considered, or insufficiently considered, in the preliminaries are:

(1) The cost of construction of dams, retaining walls and other works.

(2) Unreliable values for material used in construction.

(3) Additions or extension.

(4) Improper or insufficient knowledge of engineering details, which determine the nature of construction best suited to the environment.

These items refer especially to water-power undertakings, and are embraced under two general headings:

(a) Physical equipment, or the construction.

(b) Organization and finance.

The first should account for the building of every part of the plant, including all temporary construction, alterations during construction, and extensions or improvements usually regarded as belonging to "extras."

The second item considers the cost of promoting the development, the cost of organizing, interest on bonds during construction, operating costs, plus the excess interest on bonds before plant begins to return dividends, and finally a sum to be used for working capital.

In preparing estimates of proposed developments the above factors must be weighed with extreme care, in order to determine as closely as possible the value of the property. The unfortunate fact is too often revealed that the owner or financier is reluctant to take up a proposition which shows the cost to be above a more or less arbitrary value; consequently the inexperienced promoter will not let himself or his associates believe that the profits cannot be as glaring as they are made to appear.

In order to arrive at definite conclusions with reference to the plant assumed, it is well to tabulate the items in detail which belong to each type of station. Those of the hydroelectric development are assumed as follows:

COST TO ORGANIZE AND FINANCE.

Organization, promotion, water rights, etc.	$ 100,000
Interest on bonds during construction at 5 per cent of face value	110,000
Excess bond interest and operating cost above earnings for one year	20,000
Cost of advertising, etc., previous to earning period	10,000
	$ 240.000

ESTIMATED COST OF EQUIPMENT INSTALLED.

Hydroelectric station, 10,000 K. W. capacity at $120 per K. W.	$1,200,000
Substation, 9,000 K. W. capacity, at $7 per K. W.	63,000
Transmission line, 50 miles, with suitable telephone lines and switching equipment	150,000
Reserve steam plant, 3,000 K. W. capacity, at $100 per K. W.	300,000
Mistakes, accidents, business and legal advice, etc., at 7 per cent	84,000
	$1,797,000

YEARLY FIXED CHARGES.

Interest on capital invested in equipment at 6 per cent	$ 102,780
Taxes, insurance, depreciation, 4 per cent	67,520
Administration charges	25,000
	$ 195,300

YEARLY COST OF OPERATION.

Superintendence and labor in generating plant	$ 6,000
Maintenance of generating plant	2,000
Operation and maintenance of transmission system and substation	10,000
Operation and maintenance of steam relay plant	35,000
	$ 53,000
Total annual cost	$ 248,300

Let us now consider the steam plant. Here, the matter of organizing and financing differs materially from that of the hydroelectric plant. In fact, the power market in the average case is quite definitely defined by the time the power project is contemplated and there remains only the capital to be procured for completing the design and proceeding with the construction.

Basing calculations on a steam plant having the same maximum capacity as the hydroelectric substation, namely, 9,000 kilowatts, we may consider the normal rating 7,500 kilowatts.

We may now tabulate the items belonging to the steam plant thus:

COST TO ORGANIZE AND FINANCE.

Organization, promotion, etc.	$ 40,000
Interest on bonds during construction, 5 per cent of face value	30,000
Excess cost above earnings for one year	12,000
Cost of advertising previous to earning period	10,000
	$ 92,000

ESTIMATED COST OF EQUIPMENT INSTALLED

Steam power station, 7,500 K. W. rated capacity with 20 per cent continuous overload (9,000 K. W.), complete installation at $100 per K. W.	$750,000

YEARLY FIXED CHARGES.

Interest on investment at 6 per cent.	$ 45,000
Taxes, insurance, depreciation, 7 per cent	56,000
Administration charges	14,000
	$115,000

YEARLY COST OF OPERATION.

Superintendence and labor	$ 10,000
Maintenance	4,000
Fuel—coal at $2.50 per ton of 2,000 lbs., 31,536,000 K. W. hrs., 3 lbs. coal per K. W. hr.	118,260
	$132,260
Total annual cost	$247,260

Comparing these figures we find a credit to balance of $1,040 per year in favor of the steam plant. When we consider the question of continuous service it is not unreasonable to state that the steam plant is generally superior, from the fact that there are no long-distance transmission lines which contribute to interruptions regardless of the character of the generating station and substation.

The above example assumes a first-class steam-turbine plant which is handled by a thoroughly competent operating force. It will be noted that taxes, insurance and depreciation are reckoned aggregately at seven per cent. This figure would likely be regarded as too low in the average plant. However, the same item corresponding to the hydroelectric plant, four per cent, may also be low, and in practice doubtless is low. These would, therefore, balance each other as far as the final result is concerned.

It is unquestionably correct to assume a higher administration cost for the hydroelectric plant than for the steam plant. This is because the office of the latter is concentrated, while the hydroelectric enterprise requires several offices, or at least several forces of employees in connection with the several communities to which it is related. Moreover, the legal expenses, cost of advertising and rental are apt to be considerably greater and must be adequately provided for.

SELLING AND DISTRIBUTING POWER.

The foregoing examples serve to show roughly the first costs and operating expenses, respectively, of hydroelectric and steam power produced at the switchboard ready for distribution. In order to arrive at the cost to produce power at the terminals of the consumer we must ascertain as closely as possible the cost to install and maintain the distributing system.

Let us first compute the cost per kilowatt-hour at the switchboard, since this is the basis of calculation usually desired. For either plant we have the general equation:

$$\text{Cost per kilowatt-hour equals } \frac{\text{Total yearly cost} \times 100}{\text{Load-factor} \times \text{capacity of station} \times 8{,}760}$$

For the hydroelectric plant this is

$$24{,}830{,}000 / 31{,}536{,}000 = \$0.0079$$

or 0.79 cent per kilowatt-hour at the switchboard.

For the steam plant it is

$$24{,}700{,}000 / 31{,}536{,}000 = 0.785$$

cent per kilowatt-hour.

With a station load-factor of fifty per cent this cost would be reduced to 0.7 cent per kilowatt-hour, while that of the hydroelectric station would run considerably below this figure. This shows that with a load-factor exceeding forty per cent, the hydroelectric plant can undersell the steam plant. This is due to the higher proportionate cost of fuel and maintenance of the latter. In other words, the fuel cost, maintenance and depreciation of the steam-power plant increases faster than the corresponding operating costs of the hydroelectric plant. Therefore, a hydroelectric transmission plant with a high load-factor should be able to show better profits than a similar steam plant unless the cost of fuel is abnormally low.

In computing the cost of distribution we are confronted with some very perplexing problems. The first one is the question of franchises, rights of way, and kindred legal matters. Following these problems is the cost of installing and maintaining the overhead and underground distributing mains and accessories to meet the needs of all immediate and future consumers.

Let us assume that the distributing system will cost $100,000 to install. If we allow $25,000 for extras, such as legal expenses, etc., the initial investment is $125,000. Interest on this amount at six per cent is $7,500 per year. The cost of maintaining the system involves the employment of solicitors, collectors, accountants, linemen, and a meter department, having its meter testers, trouble men, etc. These, plus the cost of generation, must be paid for by the consumers.

Assuming that the cost of all of these items is $1,000 per month, and that there are, say, 15,000 resident consumers for lighting, it would be advisable to make a charge according to a minimum rate, based upon fixed charges. The fixed charges per month, including interest cost are figured thus:

$$\$7{,}500/12 + \$1{,}000 = \$1{,}625.$$

It is noted that the cost of hydroelectric power at the switchboard averaged 0.79 cent per kilowatt-hour. This, of course, must be added to the cost of distribution. The total operating cost per month for the hydroelectric property is

$$\$248{,}300/12 + \$1{,}625 = \$22{,}316.$$

Suppose there are 1,000 consumers, each having a power load exceeding 500 kilowatt-hours per month, or a total of 500,000 kilowatt-hours per month.

If 16,000 customers must pay a total of $22,316 per month in addition to a profit of, say, twelve per cent per annum, the minimum average charge per month per consumer is

$$\$22{,}539/16{,}000 = \$1.40 \text{ (approximately)}.$$

If 500 power consumers should take 1,000 kilowatt-hours per month, they should, of course, pay less per kilowatt-hour than those consuming only 200 kilowatt-hours. It is evident then that the small (resident) consumer should pay the largest price per unit, since the cost and upkeep of the equipment per individual is proportionately large where the power consumed is small.

Without going further into the mathematical investigation of lighting and power rates, we may draw the conclusion that a well organized hydroelectric property having a fairly high curve load-factor, say, thirty-five per cent or above, is generally a success financially, and when we compare such a property with steam power of similar capacity, we must look most carefully into the fuel item, the load-factor, and other items affecting the operating cost which are not so serious with the hydroelectric plant.

However, the hydroelectric undertaking is equally uncertain where the conditions of the power market and the cost of launching the project are not fully determined.

It may be said in conclusion that the most successful electrical properties of such capacity as is herein cited are made up of a combination of steam and hydroelectric generating plants. This combination is usually such as to "round out" the power system by supplying the best features of both types, and it furnishes the ablest assurance against serious interruptions in service.

(THE END.)

ELECTRIC LIGHTING and ILLUMINATING ENGINEERING

German Regulations for Photometry of Electric Lamps.

At its last annual meeting the Society of German Electrical Engineers (Verband Deutscher Elektrotechniker) adopted standard codes of regulations for photometering incandescent and arc lamps. The first of these has to do with the measurement of the mean horizontal candlepower of incandescent lamps and is substantially as follows:

MEAN HORIZONTAL CANDLEPOWER.

By candlepower of an incandescent lamp is understood, unless otherwise specified, the mean candlepower in a plane perpendicular to the axis of the lamp and passing through the middle of its filament or light source. This candlepower is designated as the mean horizontal candlepower, since the axis of the lamp is usually vertical during the measurement.

The mean horizontal candlepower is determined by the rotating-lamp method. For this purpose the lamp to be measured is rotated about its axis placed in a vertical position by means of a rotation device. The speed of rotation is to be so chosen that no troublesome flicker results in the photometer and no dangerous bending of the lamp filament takes place. If it is impossible to avoid the latter, then another method without rotating the lamp is to be chosen, for example, the Brodhun method of rotating mirror (see Liebenthal, "Praktische Photometrie," page 331), or the method of photometering in a large number of radiating directions.

Incandescent lamps standardized by the German Reichsanstalt serve as standard lamps. The direction in which the candlepower of the lamp was standardized must be marked thereon and during the measurements must correspond with the optical axis of the photometer bench. In place of standard lamps there can also be used, particularly during prolonged measurements, other non-defective incandescent lamps. Their candlepower must be determined through direct comparison with a standard lamp. They should have been burned at least fifty hours before standardizing and they should correspond in color as closely as possible to that of the lamp to be measured. This holds true also for the intermediate light sources *B* in Fig. 2.

The illumination on the photometer screen should not appreciably exceed thirty lux. The length of the photometer bench is to be chosen to correspond to this. For candlepowers up to about 100 Hefner candles there suffices a length of bench of 2.5 meters and a standard lamp of 10 to 25 Hefner candles. The bench can be scaled off in centimeters or in terms of candlepower.

By means of black screens, preferably of velvet, foreign light is to be excluded from the photometer screen; no part

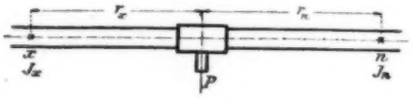


FIG. 1.

of the test lamp itself must be screened off, however.

Voltage measurements must always be made at the terminals of the lamps.

The photometric measurement is made according to one of the two following methods:

Method I.—The lamp to be measured *x*, which is placed in a rotation device, and the standard lamp *n* remain at a fixed distance apart. The photometric setting is obtained by shifting of the photometer screen P (Fig. 1).

If J_x is the candlepower of the lamp *x* which is to be measured, and J_n that of the standard lamp *n* in the direction of the axis of the photometer bench, and if r_x and r_n are the respective distances of the lamps *x* and *n* from the photometric screen when a balance is obtained, then $J_x = J_n r_x^2 / r_n^2$.

The equality of the two sides of the photometer screen is hereby assumed.

It is desirable in general to place the lamps *x* and *n* at the ends of the photometer bench and to use a candlepower graduation of the bench as calculated from the law of distances, with the division 1 midway between lamps *x* and *n*. The candlepower of the former is then equal to the candlepower of the standard lamp *n* multiplied by the number read off the candlepower scale.

Method II.—The photometer screen *A* (Fig. 2) is securely joined to an intermediate light source *B* and the two are moved together as a unit along the bench. At *C* is placed a rotation device in which is mounted the standard lamp and subsequently in place thereof the lamp to be measured. The distance between *A* and *B* must be adjustable. The photometer bench is provided with a can-

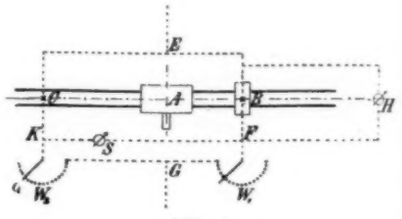


FIG. 2.

dlepower scale calculated from the law of distance, the zero point of the scale being at the axis of the lamp at *C* and the division 1 lying at a distance of one meter from this zero point.

The photometric measurement consists in the obtaining of two settings *a* and *b* one after another.

Setting a.—First of all the intermediate light source *B* is adjusted to the correct voltage. At *C* is mounted and adjusted the non-rotating standard lamp; the photometer screen *A* is set at the division 1 of the candlepower scale and the distance *AB* is varied by adjustment of *B* until a photometric balance is obtained. Then *A* and *B* are securely fastened together.

Setting b.—In place of the standard lamp, the lamp to be measured is mounted in the rotation device at *C* and properly adjusted. A photometric balance is then obtained by shifting of the photometric screen *A* together with the lamp *B* secured to it. The desired candlepower is then equal to that of standard lamp used in setting *a* multiplied by the figure read off on the candlepower scale.

Connections.—By both methods I and II the following connections may be employed:

If constant potential is available, then direct connection can be used. Each lamp has its individual circuit, in which there is a regulating resistance and an ammeter. At the terminals of each lamp is a voltmeter.

If the voltage is fluctuating, the differential connection indicated in Fig. 2 is employed. The voltages of the lamps to be compared must not differ very greatly. In the parallel branch circuits *EFG* and *EKG* there are placed on the one side the lamp *B* and the regulating resistance W_1 and on the other side the lamp *C* and resistance W_2. Between *K* and *F* is connected a low-reading voltmeter; aside from this there is connected across *B* a voltmeter *H*, which serves to indicate when the proper voltage has been supplied to *B* through the aid of W_1; the lamp *C* receives its proper voltage in every case since by means of W_2 the proper difference of potential between the lamps *C* and *B* is adjusted on the voltmeter *S*.

PHOTOMETRY OF ARC LAMPS.

Before the photometric measurement the lamps are provided with electrodes of the specified diameter and type and of a length which is equal to about half the active burning time of the lamp between trims. The lamps are burned in normal condition for one hour. Directly after this follows the photometric measurement, without disturbing the attained condition of constancy by removal of the globe or otherwise. The arc lamps must be adjusted during the measurement so that their average current agrees with that specified for them. With alternating current the adjustment of the lamp should correspond as closely as possible during the photometric measurement to the practical requirements.

The determination of the mean lower hemispherical candlepower is made either by means of an integrator (Ulbricht globe) or by obtaining the mean polar curve.

In using an integrator a sufficiently large number of readings must be made in nearly equal time intervals in order that the true mean value of the candlepower may be obtained.

The mean polar curve for determining the mean lower hemispherical candlepower is obtained by measuring simultaneously at two directly opposite sides of the lamp and at nearly equal time intervals point by point the entire radiant surface in the lower hemisphere, moreover in vertical as well as horizontal direction, by advancing at angles of ten degrees at the most. Therefore for this point-by-point determination there are required a total of at least 325 readings of the light-radiating surface.

The readings are preferably made in this manner, that for each adjustment of the vertical angle of the light radiation of the lamp, the latter is rotated by means of a suitable arrangement and at least thirty-six readings are made around that circular zone. The vertical angles are measured from the downwardly directed vertical axis.

In measurements with the Ulbricht globe the horizontal plane bounding the lower hemispherical candlepower is taken though the light center. The Ulbricht globe must have a diameter of at least 1.5 meters.

Gas and Electricity for Display Lighting.

In speaking of the recent coronation illuminations in London, a writer in an English electrical journal says: "In conclusion, it is interesting to note the advantages and disadvantages of electrical illumination compared with gas. The gas shimmering effects in crystal devices cannot be obtained by electricity, but on the whole the electrical designs were very much more effective, especially in exposed positions, where, in many cases, especially on Thursday night, half the gas jets were blown out, and made a stronger appeal to the observer's nose than to his eyes. From an artistic point of view, moreover, electricity proved to be a more suitable medium for securing the individuality which was so noticeable in a number of instances. The gas effects appeared to be rather stiff and stereotyped."

Electric Lighting of an Old Castle.

Among the considerable alterations which were made to Carnarvon Castle in connection with the investiture of the Prince of Wales was the introduction of electric lighting. The supply is obtained from the local central station, about 10,000 candlepower in lamps being used.

Free Street Lighting at Niagara Falls.

Several of the principal streets of Niagara Falls, Ont., have been equipped with electric lights, the cost of which was donated by merchants, while the current for lighting is supplied free by the different power companies.

LETTER TO THE EDITOR.

Street Illumination.

To the Editor:

Will you kindly call attention to the following typographical errors in my article on "Street Illumination" in your issue of July 15?

The ordinates for the curves for the 500-watt tungsten lamp, opal globe; for the four-ampere Westinghouse magnetite arc; and for the six-ampere inclosed direct-current arc should be given in tenths of foot-candles instead of in foot-candles. The decimal points were omitted. In the last paragraph in the article the statement is made that the Westinghouse magnetite arc was 38 feet high, all other lamps 28 feet. These figures should be 35 feet and 25 feet respectively.

W. T. Ryan.

Pittsburg, Pa., July 22, 1911.

Flaming Arcs Again Used for Arena Lighting.

During the present week, July 24 to 30, a national military tournament was held in Grant Park, Chicago. This was somewhat similar to the one held a year ago, but was participated by both national and state troops. The most striking feature was open-air afternoon and evening exhibitions given in a large arena which, as last year, was illuminated by means of eighty flaming-arc lamps, suspended as described in the Electrical Review and Western Electrician of July 16, 1910.

Rubber Substitute.

It is claimed that the soya, or Manchurian bean, makes a capital substitute for rubber. It is an annual, growing extensively in Japan and the East Indies, and somewhat resembles the kidney bean cultivated in this country. When treated with nitric acid and alkalis, and subjected to great heat, it develops into a rubber substance that can be vulcanized.

British Telephone Transfer.

The British Post Office has now agreed to take over the whole of the National Telephone Company's plant at the end of the year, including the twenty-three "condemned" exchanges, instead of leaving these and other parts of the plant on the Company's hands. The price paid will be determined with regard to the relative suitability of the plant under the new conditions.

TELEPHONY—TELEGRAPHY, and WIRELESS.

LINE-CONDUCTOR REQUIREMENTS FOR TELEGRAPH TRANSMISSION.[1]—II.

BY FRANK F. FOWLE.

Duplex and quadruplex transmission have been fully presented in the author's paper before the American Institute of Electrical Engineers, previously mentioned, and those who are interested are referred to that paper. Formulas have been deduced in each case for the length of line, or operative limit of distance, in terms of the wire resistance, leakage, terminal resistances, relay operating currents and the voltages. These need not be given here, but the results of a full set of calculations will be presented for each case.

Polar duplex transmission was investigated for the differential method, assuming 800-ohm polar relays, a terminal lamp resistance of 300 ohms and a maximum line current of thirty milliamperes. The assumed properties of relays were those obtained from very careful tests.

In the case of quadruplex transmission, the polar side was not specially considered, because it had already been treated in the simple duplex. The neutral side, which is the least stable, was therefore the principal consideration. The results given later for the differential quadruplex assume full service on all four legs, but as already implied, the polar side will operate under far more severe conditions than the neutral side. The polar relay was assumed to have a total resistance of 400 ohms and the neutral relay 800 ohms. The lamp resistance was taken at 600 ohms and the short-end electromotive force as ninety volts, with a ratio of high to low electromotive force of 3.5 to 1.0. The neutral relay here assumed was chosen from several types tested and was the most efficient one of all. The lowest commercial operating current in either of the half-windings was thirty milliamperes, which was assumed in calculations.

Tests of these relays are more fully described in the American Institute paper, which you may find of assistance in selecting efficient types for your own requirements. This applies especially to duplex and quadruplex relays, in which there is considerable variation between different designs, in operating characteristics.

The use of the Field key system does not affect the application of the present theory in any way, but there are certain features which it is well to observe and these you will find described in an article on the subject in the *Telegraph and Telephone Age*, of October 1, 1910, by the author.

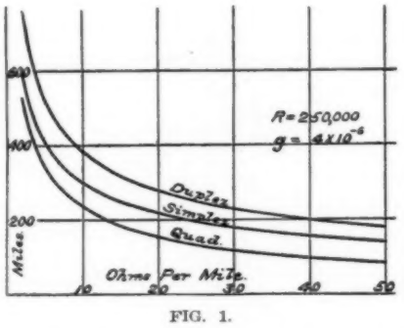


FIG. 1.

The final results are shown in tabular form in Table 2.

TABLE 2.

OPERATIVE LIMITS FOR DUPLEX, SIMPLEX AND QUADRUPLEX TRANSMISSION.

Line Resistance in Ohms. Per Mile.	Line Limit, in Miles. Duplex.	Simplex.	Quadruplex.
2	783	597	531
3	658	510	442
4	580	450	386
6	485	376	313
8	425	331	268
10	384	299	236
15	318	248	186
20	278	217	156
25	250	195	135
30	229	179	120
40	200	156	98.7
50	180	140	84.3

The term simplex as employed in Table 2 refers to single working, in contrast with double (or duplex) and quadruple (or quadruplex)working, and not to a simplexed telephone circuit.

For the purpose of selecting the proper line resistance when the length of the line is not given in the table, the values in Table 2 have been plotted as curves which are given in Fig. 1. The table and the curves exhibit several well known facts, which were derived originally from experience. Taking a wire of given resistance per mile, it will work farther in duplex service than in simplex or quadruplex service; and for simplex service it will work farther than the neutral side of a differential quadruplex. Or stated in the descending order of stability and operative margin, the duplex comes first, simplex second, and quadruplex last.

Duplex transmission is by far the cheapest of the three kinds of service, because it requires a conductor of much less conductivity than simplex or quadruplex service. The curves also show that the duplex will operate with a wire more than double the resistance required by the full quadruplex. Or two wires for duplex service would weigh less than one wire for quadruplex service and handle an equal amount of traffic, always assuming uninterrupted service. There is still another advantage; two wires are not likely to be in trouble —and out of service—at the same time, so that service interruptions caused by wire failures would be less serious with the duplex layout.

In the course of checking the tests of quadruplex relays, and the theory in general, a study was made of the operating conditions on a 500-mile quadruplex circuit of No. 9 B. & S. copper (209 pounds). The relays from one end of this circuit were among those tested, and a comparison of the minimum commercial operating current, as determined by laboratory tests, with the minimum in practice, agreed within seven or eight per cent, a fairly close result where judgment comes into play to some extent. The neutral side of this quad failed when the average calculated insulation resistance fell below 0.78 megohm per mile, which occurred with every heavy rainfall over the whole line, quite a number of times per year.

1 A paper presented before the Association of Railway Telegraph Superintendents at its thirtieth annual convention, Boston, Mass., June 27.

BENEFITS OF HIGHER INSULATION.

The results thus far presented are based on conditions taken to represent the average, as found in practice. Among the obvious means of improving transmission, which resulted from this study, is the rather simple expedient of improving the insulation. As already pointed out, doubling the insulation resistance will halve the weight of the conductor; if the terminals remain the same in each case, the weight will be even slightly less than half.

The following results calculated for a wire of ten ohms per mile, with 300-ohm terminals and various degrees of insulation, illustrate the case clearly. Simplex transmission is assumed.

TABLE 3.
OPERATIVE LIMITS OF TELEGRAPH LINE WITH VARYING DEGREES OF INSULATION.

Insulation Resistance per Mile, in Megohms.	Operative Limit of 10-Ohm Wire, in Miles.
1.000	624
0.500	433
0.250	299
0.125	204

The length of the line increases slightly faster than the square root of the ratio of increase in insulation resistance. For example, increasing the insulation

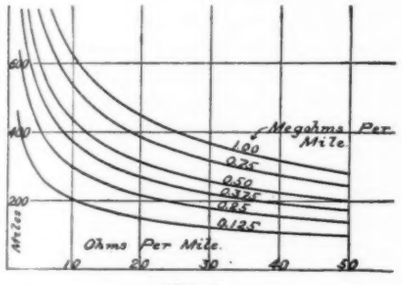


FIG. 2.

resistance from 0.25 megohm per mile to 1.00 megohm, a rate of 4, increases the line distance from 299 miles to 624 miles, or a ratio of 2.09.

Under existing practice it is well known that working 600 miles through all weather is a very severe requirement for No. 9 B. & S. copper, with a resistance of about 4.3 ohms per mile; in fact, it may fail occasionally, in the heaviest weather, and will surely fail whenever the insulation falls to the average value of 0.25 megohm taken as the average minimum. At the latter value, a 624-mile line would require No. 5 B. & S. copper, weighing 529 pounds per mile.

It requires no elaborate argument to establish the fact that higher insulation will be a great advantage and of economic value.

Fig. 2 shows by means of curves the effect of both higher and lower insulation resistance, assuming the previous terminal conditions, for simplex working. The lowest curve in the figure shows the results for 0.125 megohm per mile, and other curves follow above it in order, for 0.25 megohm, 0.375 megohm, 0.50 megohm, 0.75 megohm and 1.00 megohm per mile. These results need no further elucidation.

EFFECTS OF RELAY ADJUSTMENT.

The ability of an operator to adjust his relay properly for working on low margins is also an important factor. This is a matter of instruction and education, primarily, but in order to show its importance the following values of the operative limits with a ten-ohm line have been calculated, and are given in

TABLE 4.
EFFECT OF RELAY MARGIN ON OPERATIVE LIMITS OF A 10-OHM WIRE.

Currents, in Milliamperes. Operate.	Release.	Margin.	Value of n.	Operative Limit, in Miles.
50.0	40.0	10.0	5.00	335
50.0	37.5	12.5	4.00	299
50.0	35.0	15.0	3.33	269
50.0	32.5	17.5	2.96	249
50.0	30.0	20.0	2.50	221
50.0	25.0	25.0	2.00	181

An increase in the margin from 12.5 to 15.0 milliamperes, for example, caused by the operator's lack of knowledge or skill, drops the operative limit from 299 miles to 269 miles; or a twenty per cent increase in necessary margin shortens the line ten per cent. Other examples can be easily computed from the table, but the essential point is to secure the lowest possible margin for commercial service.

EFFECTS OF TERMINAL RESISTANCE.

In order to show how the increase of terminal resistance decreases the operative limit, the following calculations have been carried out for a line of ten ohms per mile, assuming as before that n has a value of 4. The results are given in tabular form in Table 5 for terminal resistances ranging from nothing up to 800 ohms.

TABLE 5.
EFFECT OF TERMINAL RESISTANCE ON OPERATIVE LIMITS OF A 10-OHM WIRE.

Terminal Resistance, in Ohms.	Operative Limit, in Miles.
0	326
100	317
200	307
300	299
400	291
500	283
600	276
800	262

The ideal value of terminal resistance is zero, and a value of 300 ohms cuts down the operative limit from 326 miles to 299 miles, or 8.3 per cent. A resistance of 600 ohms cuts down the limit 15.3 per cent.

In this respect generators are more efficient than gravity batteries, because of their low internal resistance, and in comparing the cost of the two for equal transmission distances, the battery will require a slightly larger wire for equal results and should be charged with the additional cost. This produces a more favorable showing for generators, or dynamotors, than the comparison of actual cost, leaving the line out of consideration.

The advantages of generators can be quite largely sacrificed by the use of lamps of unnecessarily high resistance in the taps, and it is important to keep the lamp resistance at the lowest point consistent with safety. Carbon filaments should not be used, because their resistance decreases with the increase of current; iron, on the other hand, possesses the opposite characteristic and is quite satisfactory.

DESCRIPTION OF ARTIFICIAL LINE.

In order to demonstrate the leakage theory in general, and especially to show

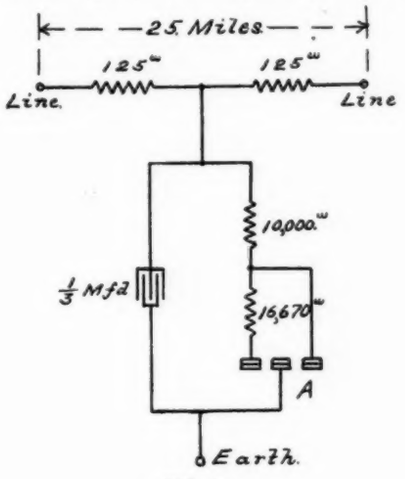


FIG. 3.

the possibility of employing wires of relatively high resistance for long lines, under conditions of high insulation, an artificial telegraph line has been constructed with the following properties or constants.

It normally represents a line 500 miles long having a wire resistance of 10.0 ohms per mile and an insulation resistance per mile of 0.25 megohm. In order to make it approximate very closely to the corresponding real line, whose resistance, leakage and capacity are uniformly distributed, it is divided into twenty sections, each twenty-five miles in equivalent length. The wiring of each section is shown in Fig. 3. The sections are joined together in series, and arranged with cut-in jacks, so that various lengths less than 500 miles can be obtained for experiment. The leak resistance of 10,000 ohms provides the equivalent of 0.25 megohm per mile, for

a 25-mile section. Then by throwing the switch *A* an additional leak resistance of 16,670 ohms can be inserted, making the total 26,670 ohms, or the equivalent of 0.667 megohm per mile.

The inductance of an ordinary telegraph line is small, and so far as it affects transmission in the present instance can be neglected. The electrostatic capacity of a No. 9 B. & S. wire, of any material, at a uniform height of twenty feet from the earth, would be 0.00990 microfarad per mile, if not in the presence of other parallel wires. But the latter cause the true capacity to increase somewhat, depending on their number and proximity. A 25-mile section would require, on the single-wire basis, 0.247 microfarad, but a condenser with a nominal capacity of 0.3 microfarad has been used; the actual capacity is a little higher than the rating, however, being probably 0.33 to 0.35 microfarad, and represents an increase over the theoretical requirement of thirty to forty per cent.

The operative limit of such a line, with an insulation resistance of 0.25 megohm per mile, 300-ohm terminals and a value of n equal to 4, is 299 miles. But when the insulation resistance is increased to 0.667 megohm per mile, the limit is 505 miles, under the same terminal conditions. The essential purpose of this model is to demonstrate the facts just stated.

At each terminal there is a 150-ohm standard relay, a key and a sounder; also a 100-ohm resistance lamp. The total voltage required to produce a line current of fifty milliamperes, with no leakage, is 180 volts for 300 miles and 280 volts for 500 miles, this is distributed one-half at each terminal.

RELATIVE COSTS OF DIFFERENT KINDS OF LINE WIRE.

Under the leakage theory of transmission here developed, the proper basis for comparing different kinds of wire is one of equal conductivity or resistance. This basis, however, only applies to the purely electrical requirements. Equally important is the requirement of tensile strength, including the allied mechanical properties of modulus of elasticity, elastic limit and temperature coefficient of expansion.

Copper and iron have been standard materials for many years, although the so-called iron now obtained is usually mild steel. In the last five years there has appeared on the market a new type of wire known as copper-clad steel, with whose properties some of you are familiar. The characteristics of such conductors have been quite fully treated in a series of articles by the author in the *Electrical World* of December 22 and December 29, 1910, and January 12, 1911, to which you may refer for full details.

Fundamentally this wire consists of a steel core with a copper shell or jacket welded thereto, thus avoiding the faults of the early bi-metallic wire. Comparing it size for size with copper and iron, it has more resistance than copper, but less than iron; that is, it is intermediate between the two. But mechanically it is superior to either. Now first of all we need to know how these materials compare in cost for equal resistance.

The proper cost to consider in this case is annual cost, or the sum of the annual interest charges, taxes, depreciation and maintenance. The first cost and the annual cost have been computed for several sizes of each kind of wire, including in the first cost only the wire, insulators, tie-wires, pins, joints and labor of installation—but no pole-line cost. Interest and taxes have been taken collectively as seven per cent annually, and maintenance as uniformly $1 per wire-mile. The total depreciation has been found by deducting the salvage or scrap value from the first cost and adding the cost of taking down the wire when it is worn out; the whole sum has then been divided by the number of years of life, to find the annual depreciation.

The base price used for copper wire is 13.5 cents, with a salvage value of 11.25 cents at the smelter; a small freight allowance has been included both ways.

The base price of copper-clad, current on the same recent date, was 13.25 cents less three per cent for cash in fifteen days and seven per cent for quantities exceeding 15,000 pounds. The salvage price was 3.5 cents, based on actual inquiry of second-hand metal dealers. A freight allowance was made both ways.

The current price of B. B. galvanized iron, which is cheaper for simple conductivity than E. B. B. iron or steel, ranged from 3.25 cents to 4.00 cents, according to size. No scrap value was allowed.

(To be concluded.)

Life of Telegraph Poles.

The average life of telegraph poles in Germany is 14.5 years, according to statistics compiled by Dr. Moll.

Telephone Lines on Postal Poles.

The Postal Telegraph-Cable Company has decided to allow independent telephone companies to string wires on its poles on certain conditions.

The following instructions on the subject have been issued to all superintendents of the Postal system by E. J. Nally, vice-president and general manager:

"In order to increase our facilities and create a new source of income, our company has decided to make an offer to independent telephone companies of allowing them to string wires on our poles at the usual rental, varying, according to the different localities, from $4 to $6 per mile, per wire, per year, on the condition that we shall be allowed to composite their wires so strung on our poles where it will not interfere with their telephone use, and that we shall be allowed without charge to use the telegraph circuit whenever we wish.

"We have at various places telephone circuits which we can lease at once, and are willing to lease to responsible independent telephone companies. At other places we have copper wires which can be transposed, and we are willing to lease the telephone side of these wires. In all other places we are willing to string copper wires at our own expense, on our own poles, and lease the telephone side of the circuits to responsible independent telephone companies; provided, first, that the telephone company will in each instance contract to keep the lease for five years; and, second, provided that the wires will probably be of use to us upon the termination of the lease—in other words—between commercial centers."

Telephones in Constantinople.

An item appearing in the *London Times* states that a telephonic survey is being made of Constantinople with the intention of installing a system having an initial capacity of 10,000 lines. The line is to be in operation before July, 1913.

A peculiar feature of this installation is that there is no precedent to follow, inasmuch as all modern facilities were debarred by the ex-Sultan. There are, for that reason, no available data whereby to gauge the probable use of the service or the probable composition of the population of Constantino-

ple, about one-half of which consists of non-Moslem races, Greek, Armenian, Jewish and so on, makes the business part of the engineering study one of much complexity. Three languages are current—Turkish, Greek and French—while many more are spoken, and the variety of local customs and practices is probably greater than in any other large city in the world. No exact statistics exist, but the population of the area is estimated at between 1,000,000 and 1,250,000 inhabitants. Means of communication are at present so primitive and expensive that a large demand for the telephone service may be anticipated.

The Train Dispatcher and the Telephone.

Train dispatching has been revised and revolutionized time and again in the effort to keep pace with advances in other departments of railway operation, but with modern equipment, ballasted roadbeds, improved grades, automatic block systems and the standard code of rules, train dispatching still follows in the wake of advanced methods, struggling to overcome the obstacles incident to heavy and rapid traffic. Despite the fact that invention has made wonderful strides in providing labor-saving devices and safety appliances, the train dispatcher has not been lifted very far from his old position of heavy nervous strain and responsibility. Today, as always, he stands directly in charge of the movement of trains. His success depends upon his ability to quickly foresee and forestall. He is, in one respect, the most independent, and in another, the most dependent, employee of a railroad. No one can stand over him and successfully direct his work, while, on the other hand, without the co-operation of officials, train and enginemen and operators, he is a failure.

The telegraph, in recent years, has been the ever present "sticking brake" to the train disatcher. It prevents quick and effective communication of orders to the men who are to execute them. The dispatcher's work has been so far behind his thought that the effect of a well-laid plan is often lost before it is possible to transmit the required orders to all concerned. Telegraph operators at way stations are too frequently amateurs and are often sadly incompetent. The suspense and mental strain upon the dispatcher while calling offices for orders or to procure information incident to the movement of trains, has made physical and nervous wrecks of many otherwise successful men.

The use of the telephone for operating trains is one of the greatest steps ever taken by the railroads to put the train dispatcher on his feet. The bell in place of the telegraph call solves the problem for prompt service on the part of the operators. Good English in place of the Morse alphabet eliminates the poor telegrapher from the dispatcher's category of troubles, and reduces misunderstandings to a minimum.

The telephone permits an element of personality to enter into the work, which is far reaching in its good effect and which is impossible with the telegraph. Direct communication with conductors, engineers, yardmasters and officials, in cases of congestion, engine failures, accidents or severe weather, permits of a more thorough understanding of conditions and quicker action in making arrangements to overcome irregularities than is possible through a number of telegraphic messages.

Prejudice against the telephone on account of its liability to get out of order and the interference of outside persons, is ungrounded when the system is properly installed and where proper discipline is maintained among employees having access to the instruments. The telephone will work satisfactorily through weather conditions which often render the telegraph useless. All other things being equal, it is fair to say that a dispatcher can handle one-third more business on a single track with the telephone than with key and sounder, and do it with less effort and with less delay in traffic.—*Railway and Engineering Review.*

The Corrosion of Lead Sheaths of Telegraph Cables by Stray Currents.

Professor Pionchon has carried out some investigations on corrosion by stray currents for the telegraph authorities in Dijon, France, and has reported the results in *La Revue Electrique.*

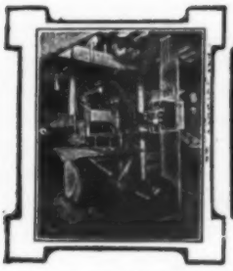
By taking continuous records of the potential difference between two points in the water pipes he showed that an electric current was flowing through the same; at night time when the street railways were not running the registration became a straight line, and during the day electrical conditions were dependent upon the operation of the cars. Analogous results were obtained by measuring the difference in potential between the flowing water and a nearby railway track, the voltage reaching a value as high as twelve volts. Similar results were obtained between telegraph cables and the rails, the observed voltage being considerably in excess of any that might be formed by lead, earth and rails acting as a primary battery. The direction of the current flow was from the lead cable-covering to the rails, and consequently the lead became corroded. As a further test of the fact that current was flowing from the lead sheath, cotton which had been soaked in a solution of potassium iodide was placed between the lead sheath and the wall of the conduit. This cotton became discolored within a few hours by the passage of current in the day time, but at night no effect was observed. In other parts of the city it was found that the direction of current flow was away from the rail and as high as twenty-five volts was observed at certain points.

Wireless Stations in Borneo.

The Marconi Wireless Telegraph Company has established wireless communication in Borneo between Tarakan, the chief port for petroleum export, and the harbor of Balckpapan, where the German Dutch submarine cable ends, 300 miles from Tarakan. Communication will also be secured between these stations and Sitve-Bondo in Java (400 miles), and Koepang, in Timor (700 miles). The plant at Balckpapan comprises a two-phase system of 2,000 volts and fifty cycles. The masts are over 200 feet high. At Tarakan there is a thirteen-kilowatt 200-cycle alternator and three masts, one 250 feet and two 150 feet high. The wave-length for ordinary work is from about 2,600 to about 2,950 yards, but much shorter waves from 325 to 650 yards can be used.

Wireless in Norway.

A new wireless station at Bergen, Norway, has been proposed, and if the scheme is put through it will be powerful enough to exchange communications with Holland, England, and Iceland. A large station will be established at Tromso, with which communications with Spitzbergen and with the western parts of the Siberian coast will be secured.



Industrial Power

THE ELECTRIC REFINING OF STEEL.

BY GEORGE ETHELBERT WALSH.

When nearly ten years ago in the little village of Darfo, in the northern part of Italy, an Italian metallurgist, named Captain Stassano, set up an electric furnace, and proceeded to make steel, the Imperial Patent Office at Berlin sent a representative to make a study of this invention, and the report, among other details of a technical nature, contained words to the effect that the electric furnace was destined to produce great revolutionizing results in the iron and steel industries. The Stassano electric steel furnace immediately became an important factor of great potential possibilities in the manufacturing world, for it meant, if successful, that pig iron and steel could be produced in countries where coal was scarce and almost prohibitive in price, provided there was water power which could be harnessed and economically converted into electricity. Stassano, in his arc furnace, succeeded in making not only pig iron but also steel direct from the ore, and with pure ores such as can be obtained in Italy he made steel of any required grade by using suitable fluxes and varying the quantities of carbon.

The use of the electric furnace for steel production has extended to half a dozen different countries since, and a dozen different patents on electric furnaces have been taken out abroad and in this country. The revolutionizing effect that the Stassano furnace was to make in the iron and steel trade did not materialize as fast as many engineers had prophesied. While electricity rapidly revolutionized many other industries, and created for itself a whole line of metallurgical successes, its use in the steel trade remained largely of an experimental nature, except for the operation of labor-saving machines. In 1906 the Canadian Government voted $15,000 for experiments in electric smelting. The primary object of the experiments was to find out if the Canadian magnetites and ores containing large percentages of sulphur but little manganese, which are very abundant in Canada, could be smelted to produce pig iron of high quality. Another question to be solved by the experiment was to see if charcoal and peat coke could be successfully used as reducing agents.

Canada had abundant water-power sites and plenty of ores of a certain grade, but little available coal. The electric furnace established at Sault Ste. Marie, Ontario, proved a success in showing that a low sulphur pig iron could be produced in the electric furnace from high sulphur ores, and also that charcoal and peat coke could be used satisfactorily as reducing agents as a substitute for coke. But the most important results of this experiment was that a pig iron of good quality was produced from titaniferous iron ores containing seventeen per cent of oxide of titanium. This fact immediately made available for electric smelting the immense deposits of titaniferous iron sands of the St. Lawrence River and many titaniferous iron ore deposits that are quite useless for the blast furnace.

The electric furnace within the past few years has assumed greater and greater importance in nearly every country where iron and steel are produced—less probably in Great Britain than in Canada, and less in this country than in Sweden or Norway on account of the comparatively high cost of electric energy here. In Great Britain, where coal is abundant and natural water power sites restricted, the electric furnace is not used extensively except for melting Swedish scrap for the production of high-class tool steel. In that country the electric furnace is finding its chief field of activity as a refiner for Bessemer or open-hearth steel.

As a melter the electric furnace has been found rather expensive, but a very economic refiner at high temperatures. It is for this reason that the United States Steel Corporation has put up a number of electric furnaces of the Heroult type. The first electric furnace in this country was set up at Boonton, N. J., by Dr. Heroult, for the purpose of producing various alloys. He made in this early furnace aluminum and then low carbon ferrochrome. This brought to the front the possibilities of making other soft metals with the electric furnace, and it was not long before he was making steel. As a result of Heroult's experiments, the United States Steel Corporation adopted this type of furnace for the manufacture of rail and structural steel. Two Heroult electric steel furnaces of fifteen-tons capacity were set up at the South Works of the Illinois Steel Company, Chicago, and another at the works of the American Steel & Wire Company, at Worcester, Mass. In these furnaces the steel treated was brought direct from the Bessemer converters for refinement.

The electric furnace in the dozen years or so of its use in iron and steel making has accomplished two distinct things which are of far-reaching effects in the industrial world. In countries such as Great Britain, Germany and the United States it has proved a most efficient and economical refiner of steel, and has made wonderful progress in the production of alloys now used extensively in steel making. In countries such as Sweden, Canada, New Zealand and Australia it has proved an important factor in the reduction of low grade ores that could not be successfully treated in the blast furnace. In this latter field it holds out great possibilities for this country if electric energy can be developed at low cost. There are millions of acres of titaniferous iron ore deposits in the United States which could be profitably treated with the electric furnace if the price of electric current was brought down to the same level as in Sweden. The possibilities in this direction are so great that in New York State alone there are sufficient deposits of low-grade ores to supply the whole country with all the iron and steel needed for many years to come.

In Sweden electric smelting has pro-

gressed rapidly in the last four or five years. There are vast deposits of low grade iron ores in Norway and Sweden, and owing to the topographical conditions of the countries electric energy can be developed at comparatively low cost. In the dozen or more electric furnaces in operation, the success of smelting has proved typical. A comparative cost of production of pig iron in the charcoal blast furnace and the electric shaft furnace in Sweden is given as follows by Prof. Von Odelstierna, of Stockholm, Sweden:

CHARCOAL BLAST FURNACE.

Charcoal, 0.95 ton at $8 per ton	$ 7.60
Labor	1.00
Repairs and general expenses	1.50
Total	$10.10

ELECTRIC SHAFT FURNACE.

0.27 ton charcoal	$2.16
0.3 E. H. P. year at $12	3.60
Labor	1.00
10 lb. electrodes, at 3 cents per lb.	0.30
Repairs and general expenses	1.50
Total	$8.56

This saving of $1.55 in the production of pig iron is of great importance, and is even improved upon in other places where current is cheaper. For instance, at the Trollhätten Water Power Company's three electric furnaces for the production of pig iron, the price of the current per horsepower per year is placed at $7.45 for the first ten years, and $9.93 for the next ten years, which is considerably less than the $12 given in the above table of costs.

Norway, Sweden and Canada have adopted the electric furnace for smelting their peculiar iron ores, and they are making steady advances in the work. Owing to local conditions electric smelting must be for them the only solution of the problem of competition with other countries more favorably supplied with coal. The possibilities of the industry in either country is limited only by the available water power that can be economically harnessed.

On the Continent of Europe the electric furnace as a refiner of steel has made almost equal advances in the last four or five years. In Germany they have been making in the electric furnace steel rails intended for exceptionally hard wear, and the cost has not proved excessive for the quality of the work obtained. Besides steel rails, the Germans are making in the electric furnace all kinds of fine steel employed as axles, tires, springs and tools. In Great Britain the electric furnace is similarly employed, though in a more limited way than on the Continent. Nearly all of the modern types of electric furnaces are capable of making steel of the highest quality from common scrap. The high temperature obtainable in the electric furnace, and the freedom of the steel from oxidation, give exceptional fluidity to the metal, and as this is particularly suitable for the manufacture of sound castings, the companies have been very successful in the production of castings from practically dead or soft steel.

But probably the most notable achievement of the electric steel furnace in this country, and in many of the European countries, is in the production of alloys now extensively used in the manufacture of high-grade steels. The steel manufacturer of today uses a great variety of alloys for increasing the tensile strength of his material. A very small addition of vanadium or ferrochrome makes the steel so strong that it cannot be easily broken. The automobile trade has greatly benefited by the production of these alloys on a large scale, and axles, springs and frames are made today of steel strengthened by alloys that are a hundred per cent better than the best steels of a decade ago. Thus ordinary open-hearth steel has a tensile strength of 60,000, but nickel steel, made by adding a quantity of nickel, has a tensile strength of 110,000, and nickel-chrome steel of 180,000, and steel treated with vanadium a tensile strength of 228,000.

The two alloys most commonly consumed in the steel trade are ferrosilicon and ferrochrome. The former above fifteen per cent cannot be produced commercially in the blast furnace, and the average is about ten per cent, but in the electric furnace ferrosilicon from 25 to 80 per cent can be produced.

Ferrochrome has been made in the blast furnace up to sixty per cent, but it then contains twelve per cent of carbon. For all practical purposes the best the blast furnace can do is to produce ferrochrome about forty per cent chromium. In the electric furnace, on the other hand, this alloy is made containing up to 60 to 70 per cent of chrome and 6 to 9 per cent of carbon. Low carbon ferrochrome with less than four per cent carbon is also successfully made by several electric furnaces. In France an exceptionally low carbon ferrochrome, containing one per cent or less of carbon, has been produced, and this is used extensively in the manufacture of chrome and tungsten tool steels. Nickel ferroalloys, ferrotungsten, ferromolybdenum and other alloys are being produced by the electric furnace on a considerable scale abroad and in this country.

The electric furnace, either for the refining of steel or for the production of alloys for steel making, has made less headway in this country than abroad. We are even behind Canada in this respect, considering the size and extent of our resources. This condition has been attributed to the more extensive electrical current. We have cheap electrical energy in the vicinity of Niagara and other big waterfalls, but the distance from the iron and steel centers makes it of little value. The effort is now being made to overcome this by the utilization of gas engines for the generation of electric power. Both the gas producer, and the utilization of the waste gases from the blast furnaces, promise important developments in the production of cheaper electric current. The United States Steel Corporation has erected some of the largest gas engines in the world at Gary for the production of electricity, and the cost is only slightly greater than that of generating current from water power.

The gradual improvement in the designs of the electric furnace in the last few years has naturally reduced the cost of melting and refining with it, but even today it is not considered safe to assume a consumption of less than 1,700 to 1,800 kilowatt-hours per ton of pig iron produced. Any grade of pig iron can be produced satisfactorily in the electric furnace, but where fuel is cheap the blast furnace is the cheaper method of smelting. Steel of any grade can be produced in the electric furnace, and that of the very highest quality, exceptionally low in phosphorus and sulphur, can be produced by refining either Bessemer or open-hearth steel in the electric furnace better than in the blast furnace unless fuel is very cheap and electric power very high. Nearly all of our high-grade steel alloys, which have become of such importance in the manufacture of high-grade tool and special steels that they are almost revolutionary, can be produced in the electric furnace cheaper and more satisfactorily than in the blast furnace, and in this field the electric furnace has already made itself an indispensable factor. With cheaper water power or cheaper electric current generated by gas producers, the electric furnace will play a more and more important part in the refining of crucible and other steels of high quality. These

gains made by the electric furnace may differ in countries, but they are real and lasting. They obtain in Germany, Great Britain, France, Italy and the United States. But the electric smelting of ore of peculiar quality is a characteristic industry chiefly in such countries as Sweden, Norway, New Zealand and Canada, where fuel is expensive and water power cheap.

Electric Power for Brick Works.

The German Association for the Supply of Electricity last year collected information from German brick works as to power costs and cost of production. Particulars were received from seventeen works. The *Deutscher Topferund Ziegler-Zeitung* published the figures, which were then analyzed by R. Loewenherz for the purpose of making comparisons between electric and steam power (portable engines) for brick works. The results, calculated as working expenses for the production of 1,000 bricks, are very much in favor of electric power, especially in the case of the works of small outputs. The outputs of the seventeen works ranged from half a million bricks to five million bricks, and it is especially pointed out that increase in the output makes very little difference to the steam-power item, while with electric power the relative cost decreases considerably when the output is increased.

Long Acre Electric Light & Power Company Increases Capital.

The Long Acre Electric Light & Power Company of New York City, has filed at Albany a certificate for increase of capital from $50,000 to $2,500,000. This company is owned by the Manhattan Transit Company and has a franchise to furnish electric light and power in the borough of Manhattan. The company has for some time been at work reorganizing its financing and it is understood that it is now well backed with plenty of capital for immediate development. Among other things the company promises a substantial reduction of rates for electric service.

Electrical Supply in Italy.

There were in Italy last year 1,979 central stations for electrical supply and 5,148 private plants. The total consumption was 113,000,000 kilowatt-hours, an increase of eighteen per cent over the previous year.

Electrical Power for Agricultural Purposes in England.

Electrical power is now being employed for agricultural purposes in the north of England and is giving such encouraging results that its employment on a large scale in the near future may confidently be predicted. Should continued experience show that with the varying conditions of a changeable climate, great differences of soil, rainfall and levels, good results can be relied on, a revolution in agricultural methods will follow and a most important field for electrical enterprise is in view, which will extend its practical application to every large farming center in the country. The overhead electrical tramway or trolley system of our large towns has suggested the new application, as the same combination of power and mechanical appliances, which actuate street cars, are now applied to plows and to all the mechanical processes required for the successful working of a large farm.

A network of overhead wires carefully planned has been formed over a farm of about 250 acres; the soil is a stiff clay, of extensive occurrence over large areas of England, which makes ordinary plowing extremely difficult and often so costly that large areas have gone out of cultivation; if by the application of electrical power applied by overhead wires these areas can be restored use both electrical engineering and agriculture will be benefited. Steam plows have been tried, but have been found to be useless. Steam power was applied as follows: The steam engine is not attached to the plow, but moves along one end of the field; the plow is dragged through the furrow by means of a wire cable, one engine pulling in one direction and a second one at the opposite side of the field the reverse way; the plow being reversible, it has not to be turned around. With the application of electricity all difficulties have disappeared. Electrical power is applied in the same manner as steam; the motor, mounted on four wheels, is placed at one end of the field, above is stretched the overhead wire extending from field to field; the motor travels along the whole side of the field, as the plowing proceeds. The plow cuts three furrows at once and is dragged backwards and forwards by wire cables. The power can be adjusted to work rapidly through the stiffest clay; moreover, the work can be carried on continuously by electric light day and night, with relays of men. The return current is not earthed; there are two overhead wires, which are tapped with insulated flexible connections, which are readily lifted up by means of a bamboo pole and hooked over them. The cable dragging the plow works round a drum placed under the chassis carrying the motor, between the wheels. Two motors are in use for each field, one at each end, one hauling the plow one way, the other hauling it back, the drums alternately winding in and playing out the cables. As each length of furrow is completed, the motors are moved forward a yard; this is done by means of another drum and a cable laid along the end of the field, one end of which is firmly anchored. The work can proceed at three times the speed of horse plowing and none of the difficulties due to the use of steam power occur. The motor has in addition a pulley from which, by means of a belt, all the forming appliances can be worked, such as threshing machines, wood cutting, chopping machines, pumping, and so on. Harrowing, mowing, drain cutting are equally within the scope of the motor. It has not yet been applied to harvesting, but that will follow as a matter of course, as reversible reaping and binding machines are now being designed.

The power house is placed near the farm buildings and could be designed of such a size as to work several farms covering several thousand acres. A suction gas engine, with the usual gas plant, driving a direct-current dynamo at a pressure of 500 volts, has been installed. The following details give some of the results atained: thirty-two acres of extremely heavy soil, very clayey and adhesive, can be plowed to a depth of eight inches with a coal consumption of 2.5 tons. The labor employed is as follows: two men, ordinary farm hands, ride and steer the plow. one is on each of the hauling motors, while the foreman attends to the power house when necessary. Schemes are now under consideration for providing central power houses for groups of farms in wheat-growing districts.

It is reported that important reductions in cable tolls between Canada and Great Britain will take effect in near future.

FINANCIAL REPORTS OF ELECTRICAL COMPANIES.

AMERICAN LIGHT & TRACTION.

The report of the American Light & Traction Company for the month of June and six months ended June 30, 1911, compares as follows:

	1911	1910
June gross	$313,662	$286,209
Expenses and taxes	8,890	12,047
June net	304,772	274,161
Six months' gross	2,010,311	1,800,031
Expenses	55,946	57,677
Six months' net	1,954,365	1,742,354

KINGS COUNTY ELECTRIC LIGHT.

The report of the Kings County Electric Light & Power Company for the month of June and six months ended June 30 compares as follows:

	1911	1910
June gross	$376,142	$352,906
Expenses	199,834	172,712
June net	176,308	180,194
Charges and depreciation	114,242	103,672
June surplus	62,066	76,522
Six months' gross	2,342,062	2,107,060
Expenses	1,165,548	997,112
Six months' net	1,176,514	1,109,948
Charges and depreciation	674,822	610,698
Six months' surplus	501,692	499,250
Six months' net	1,176,514	1,109,948

ELECTRICAL SECURITIES CORPORATION.

The Electrical Securities Corporation has issued a report for the six months ended June 30, 1911, as follows:

Underlying and investment bond interest received and accrued	$ 163,479
Interest general account	13,687
Dividends on investment stocks received	51,346
Total income	228,512
Collateral trust bond interest	83,022
Expenses	29,540
Total	112,562
Net profit from income	115,950
Profit on sales, securities	70,235
Less discount and premium on series bonds	14,393
Total	55,842
Surplus	171,793
Surplus December 31, 1910	1,000,043
Total surplus	1,171,836
Preferred dividends	25,000
Common dividends	80,000
Total	105,000
Surplus June 30	1,066,836

EDISON ELECTRIC ILLUMINATING COMPANY OF BOSTON.

The report of the Edison Electric Illuminating Company, of Boston, for the month of June and twelve months ended June 30, compares as follows:

	1911	1910	1909
June gross	$398,622	$356,697	$293,885
Expenses	185,207	159,797	144,469
June net	213,415	196,900	149,416
Twelve months' gross	5,257,913	4,709,456	4,111,343
Expenses	2,243,276	2,107,228	1,770,956
Twelve months' net	3,014,637	2,602,228	2,340,387

UNITED RAILWAYS COMPANY.

The report of the United Railways Company, St. Louis, Mo., for the quarter ended July 1, filed with the city register, showed that 58,416,900 passengers were carried in the three months. This exceeded any other quarter's record of St. Louis street railways with the exception of the third quarter of 1904, at the height of the World's Fair, when 69,033,534 passengers were carried. Of the passengers carried the last quarter, 56,880,065 paid five cents each and the remaining 1,536,835 paid 2.5 cents each, a total of $2,882,424.

VIRGINIA RAILWAY & POWER.

The Virginia Railway & Power Company has reported to the New York Stock Exchange statement of income prior to merger for the ten months ended April 30, 1911, as follows:

Gross income	$947,543
Taxes, licenses, interest and sinking fund	547,853
Surplus	$399,690
Preferred stock dividend	111,158
Premium, interest, etc., on bonds purchased for sinking funds and adjustments	46,238
Net surplus (ten months)	242,294
Profit and loss surplus (June 30, 1910)	297,369
Total profit and loss surplus April 30	539,664

HUDSON & MANHATTAN.

The Hudson & Manhattan Railroad Company reports for the month of June compare as follows:

	1911.	1910.
Gross revenue all sources	$375,870	$324,169
Expenses and taxes	162,502	133,469
Gross income	213,368	190,700
Interest on bonds outstanding	244,105	243,958
Less interest charged to construction	55,569	73,020
Balance	188,536	170,938
Other charges	23,757	20,418
*Total deductions	212,293	191,357
Surplus	1,075	†658

*Being fixed charges applicable against that portion of the property employed in present operations. †Deficit.

From July 1 to June 30 gross revenues amounted to $4,326,520; gross income after expenses and taxes, $3,372,693; deficit after charges, $53,331.

SOUTH SIDE ELEVATED.

The South Side Elevated Railroad Company reports for the six months ended June 30, 1911, compared as follows:

	1911.	1910.
Gross	$1,202,484	$1,205,740
Expenses	816,735	823,817
Net	385,748	381,923
Charges	226,540	226,540
Surplus	159,208	155,383

Increase of Electrical Power in South Africa.

Consul Edwin N. Gunsaulus, of Johannesburg, Transvaal, reports some interesting facts relative to the progress of electricity on the Witwatersrand, as shown in the annual report of the government mining engineer. There was a large increase in the use of electrically driven machinery in connection with the mines, the horsepower of motors having risen during the year ended during the year ended June 30, 1910, from 76,299 to 108,354. Owing to the fact that the electrification of the power supply of a majority of the mines is now rapidly going ahead, this total will be largely increased during the present year. This scheme contemplates not only the employment of motor-driven turbo-compressors for supplying compressed air, but motors will also be used for winding and pumping and in a majority of cases for the mill drive. The induction motor has been chosen by many of the mines for winding purposes, this being generally the case when it was necessary to convert an existing steam hoist, but it is understood the Ward Leonard system has been adopted in most instances where a completely new winding plant was required.

The rated capacity of the stations now in process of construction by the Victoria Falls Power Company and the Rand Mines Power Supply Company, Limited, is: Brakpan, 12,000 kilowatts; Simmer Pan, 18,000 kilowatts; Driehoek, 3,000; Rosherville, 50,000 kilowatts; Vereeniging, 40,000 kilowatts. The first three are practically completed, and the Rosherville station is under construction. In addition to the supply available from the above mentioned companies, several groups of mines have their own electric-power stations either in process of construction or enlargement.

Wireless Stations for German Africa.

An important scheme is being worked out to install wireless telegraph stations in the German African colonies. Two stations have already been established in German East Africa, one at Muanza and the other at Bukaba, on Lake Victoria Nyanza. The Bukaba station has a radius of 200 kilometers, and will connect the district with Muanza, where the overland telegraph line ends, so that it will now be possible to transmit messages by wireless to Bukaba, hitherto accessible only by mail. The Muanza station has a radius of 600 kilometers, which will enable it to communicate with the chief station to be erected at Tabora next year. The Tabora installation will be capable of transmitting messages over 4,000 kilometers, which means that it will link up German East Africa with stations to be established in the Cameroons, and probably also later in German Southwest Africa. The German mail steamers plying between Germany and the Cameroons are fitted with wireless apparatus. The plan is that wireless stations will be established at all principal commercial stations of German interest in West Africa.

New Electrical and Mechanical Apparatus and Appliances.

Power-Factor Meters.

A poor power-factor can often be improved by a better proportioning of the motors to their loads, the use of a super-excited synchronous meter, or similar means, with resulting increased capacity and efficiency of the system. It is therefore important, particularly in heavily loaded plants, to know what the actual power-factor is at various conditions of the load. The introduction of direct-reading power-factor meters enables the determination of the power-factor without trouble. Their use indicates whether induction motors on a system or on any circuit of a system are properly operated, and enables the adjustment of the exciting current of synchronous apparatus to values giving the most economical power-factor, also indicating a reversal of power if it occurs.

On polyphase systems supplying a mixed load, power-factor indications are a necessity, as the calculation of power-factor from other meters is very complicated and difficult and may give very misleading results. A polyphase power-factor meter having current connection in each phase of the circuit will indicate the average power-factor of all the phases.

The illustrations show four types of direct-reading power-factor meters manufactured by the Westinghouse Electric & Manufacturing Company. These meters indicate on a graduated scale the power-factor in the circuit to which they are connected.

The power-factor meter operates on the rotating-field principle. A rotating field is produced by the current of the metered circuit passing through angularly placed coils. In this rotating field is situated a pivoted iron vane or armature, magnetized by a coil whose current is in phase with the voltage of one phase of the circuit. As the iron vane is attracted or repelled by the rotating field of the current coils, it will take up a position where the zero of the rotating field occurs at the same instant as the zero of its own field. Thus its position will always indicate the phase angle between the voltage and current of the circuit. The pointer attached to the armature therefore indicates this angle, and, by marking on the scale the cosine of the angle shown by the graduation, the power-factor is read directly. In the three-phase meter the rotating field is produced by three current coils spaced sixty degrees apart; in the two-phase meter by two current coils spaced ninety degrees; in the single-phase meter the position of voltage and current coils is interchanged and the rotating field is produced by means of a split-phase winding.

FIG. 1.—SWITCHBOARD TYPE.

Fig. 4 illustrates the movement of a type SI seven-inch power-factor meter. The winding shown within the iron ring is the stationary winding of the current coils. Inside this and not shown, are the stationary voltage winding and the pivoted armature. The laminated iron ring surrounding the winding is provided as a return circuit for the flux of the pivoted armature, so that the reluctance of the armature magnetic circuit is low.

The aluminum disk at the front of the meter is a damping disk, moving in the concentrated field of the two permanent magnets at the bottom of the mechanism. These magnets and disk have no effect whatever on the electrical operation of the meter. They serve to prevent oscillations of the pointer and thus make the readings dead-beat. The pointer therefore does not swing back and forth but comes to rest at once at its correct position.

It will be noted that in this form of power-factor meter no connection is required between the fixed and the moving elements; there being no movable coils used, there are no delicate flexible connecting strips; nor is any control spring necessary, as the controlling force is electromagnetic. The moving element is therefore very light, and the friction and bearing jewel wear a minimum.

FIG. 2.—VERTICAL SWITCHBOARD TYPE.

FIG. 3.—PORTABLE TYPE.

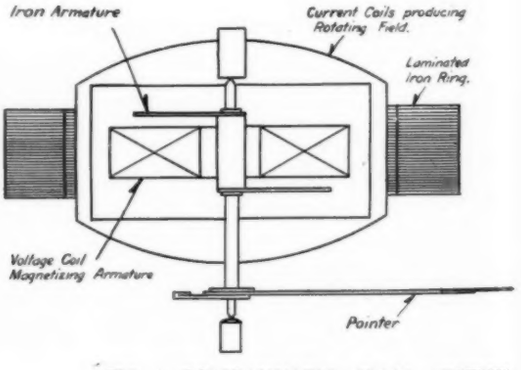
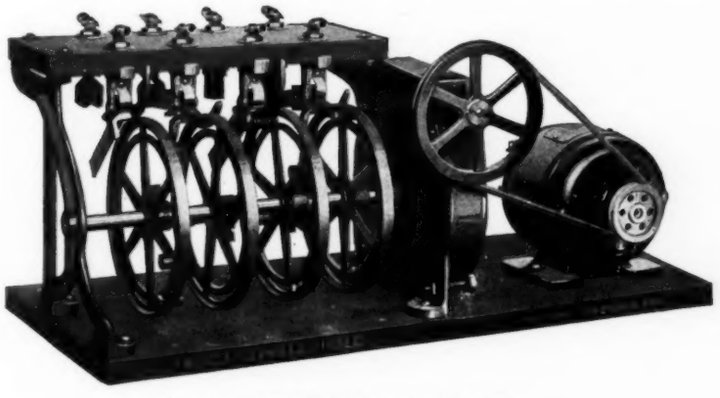


FIG. 4.—DIAGRAMMATIC CROSS SECTION.

All the Westinghouse switchboard types and the polyphase portable types are arranged to read lagging or leading power-factor on the upper half of the scale and for reversed power on the lower half. The switchboard types are adjusted for one standard frequency; the polyphase portables are adjustable to any frequency between 25 and 60 cycles. The single-phase portables indicate for 60 cycles on one half the scale and for 25 cycles on the other half. The portable meters are very convenient for investigating the power-factor of motor loads and assist very materially in improving the operation of the system.

A New Electric-Sign Flasher.

The Reynolds Electric Flasher Manufacturing Company, Chicago and New York, has recently placed upon the market a new model, as shown in the accompanying illustration.



NEW REYNOLDS SIGN FLASHER.

The switches are thrown in and out by purely mechanical action, and by means of the slots in the wheels holding the rollers, which engage the dog and throw the switch in and out, the same can be shifted or set for short or long flashes. Very frequently it is necessary to make a minor adjustment in the flasher, after the same is set up, and by means of the slotted wheels it is an easy matter for anyone to rearrange the flashing effect; this is a feature most appreciated by electricians who have occasion to set flashers.

Particular attention is also drawn to the roller bearings, on which the worm shaft runs; the roller bearings are self-contained and require no oiling; the gear drive is inclosed and is self-lubricating. There are no parts on this machine to give out, and the only parts which can burn out are the switch blades and jaws; these are made and attached in such a manner that a novice can replace the same in a few moments. This line of knife-switch type is made single, double and triple pole.

The motor is mounted on the flasher base, belted, adjusted and ready to connect. The terminals and binding posts are of ample size and convenient so that electrical connections are easily made. These machines are ruggedly constructed and are giving satisfactory service in thousands of locations throughout the country.

Reorganization of Viaduct Electric Company of Baltimore.

The plant and business of the Viaduct Electric Company at Relay Station, Baltimore, Md., has been taken over and merged into the Baltimore Machine Products Company, which was recently incorporated under the state laws of Maryland for this purpose. The following are the officers of the new company:

President, Senator A. P. Gorman, Jr.
Vice-President, E. C. Mayo.
Treasurer, Conway S. Hodges.
Secretary, Dr. W. R. Eareckson.

The Viaduct Electric Company, which has been merged into the Baltimore Machine Products Company, and its predecessor, is one of the oldest manufacturers of telephones in the country, having been in this line of work since 1871. At that time its output was confined to the manufacture of telegraph instruments and district messenger-call boxes. The firm was then known as Davis & Watts, and the plant was located on Holliday Street, in Baltimore. A few years later the manufacture of magneto telephones was taken up, and this firm became the licensed manufacturers of the American Bell Telephone Company, continuing in this capacity until 1883. The workmanship of these instruments gained for those interested in the company, and has handed down to its successors, an enviable reputation for excellence of production. A number of the magneto bells made at that time are still in use, doing good service.

In 1884 the Viaduct Manufacturing Company was formed, with A. G. Davis as president. The plant was moved to Relay, in the outskirts of Baltimore, at the junction of the Washington & Frederick lines of the Baltimore & Ohio Railroad. Here with ample room to expand and with an abundance of power furnished by a dam across the Patapsco River, the Viaduct Manufacturing Company grew and flourished, and was recognized as the pioneer and leader in the telephone industry. The manufacture of fire-alarms was added to the list of its products, as well as switchboards, both for telephone and telegraph systems. The Postal Telegraph Cable Company has always favored the Viaduct works, and for many years the Postal company has used a large part of the output.

In 1894 the entire plant was destroyed by fire and temporary quarters were taken on Warner Street, in Baltimore, where the business was continued pending the rebuilding of the plant at Relay. This required about a year and a half.

With new buildings, new machinery and greatly increased facilities the company, in 1896, moved back to its former site, where eleven new buildings, well equipped with machinery and tools, had sprung up.

The history of the Viaduct Manufacturing Company from that time is similar to that of many other concerns. While always producing the very best of work and retaining the good will of its large clientele, its managers did not seem to be able to meet the assaults of competitors, which were springing up on all sides, and a great deal of patronage was diverted to other concerns that had adopted a more modern method of doing business. In 1907 the inevitable occurred, and at the first pinch of the panic of that year the company was forced into the hands of a receiver and was succeeded by the Viaduct Electric Company. This company operated the plant for four years and made a great many improvements, both in equipment and the method of producing the goods The friends of the old company were

loyal and continued to favor its successors with their patronage. These orders increased to such an extent that the Viaduct Electric Company, having a very limited capital and burdened with a heavy load of assumed mortgages, turned the entire plant over to the Baltimore Machine Products Company, as mentioned at the beginning of this article. Many more improvements are being made by the new organization, including new machinery and increased facilities for turning out its products in a modern way.

Hot Weather Exhausts Fan Supply.

A feature of the electrical trade brought on by the hot weather is the incoming orders for electric fans. This branch of business has been exceedingly brisk for the past three months and has lately reached large proportions. In fact the large electrical companies are unable to supply the demand.

The General Electric Company has completely exhausted its surplus stocks of fans and is working its plants night and day in order to fill orders anywhere near within the time limit. The Westinghouse Electric & Manufacturing Company is situated similarly, although this is not such an important branch of the Westinghouse business.

On the whole the electrical companies are operating well over eighty per cent of capacity, which is considered favorable at this season of the year.

Lehigh Valley Railroad Extends Telephone Train Dispatching.

The Lehigh Valley Railroad has just placed an order with the Western Electric Company for apparatus to equip the west end of the Buffalo division. The new circuit is to be 135 miles in length. Thirty-eight selectors will be installed and the dispatcher for this circuit will be located in the vicinity of Buffalo.

Upon the completion of the telephone circuits now under construction, traffic on the entire line from Jersey City to Buffalo and Suspension Bridge will be handled by the telephone.

Long-Distance Telephony.

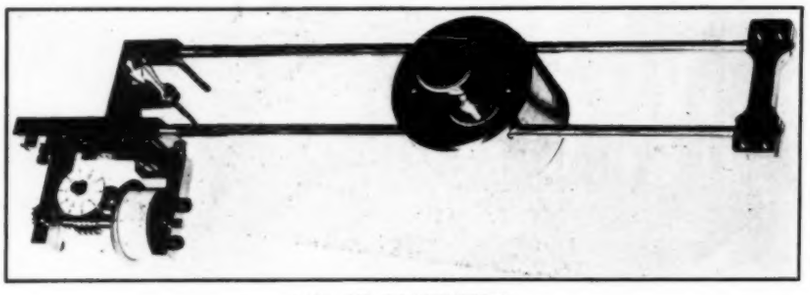
Telephone communication was recently established for the first time between Paris, France, and Aberdeen, Scotland. The distance is only about a thousand miles, but it includes submarine cable between Calais and Dover. Transmission was reported as good.

The Durand Radial Planimeter.

The great increase in recent years in the use of circular diagram or dial instruments for measuring and recording all manner of engineering quantities, such as pressure, temperature, electric voltage, current, electric power, flow of water, etc., has led to the demand for some type of instrument which will give a mean value of the ordinates of such a diagram in the same manner as does the ordinary planimeter for a diagram in rectangular co-ordinates.

The use of the common form of planimeter in connection with a radial diagram is impossible, since from the mathematical principles involved it results that such application would give the mean square of the ordinates rather than the mean ordinate as desired.

In 1908 a paper was presented to the American Society of Mechanical Engineers by W. F. Durand setting forth the geometrical elements of a form of planimeter or averaging instrument which would fulfil the desired purpose and furnish a correct mean ordinate for such diagrams, and independent of the form of the path followed by the tracing point relative to the dial, whether curved as in the usual forms of such instruments, or radial as in the common form of diagram plotted in polar co-ordinates. The only condition which must be fulfilled by the instrument is that the scale radially must be uniform. This is a condition obviously necessary to the application of any form of measuring or averaging instrument to diagrams of this character.



DURAND PLANIMETER.

One form of the instrument as developed for practical use is shown in the figure. It contains the following geometrical elements. (1) A base which is to be centered with the diagram or chart to be averaged, and carrying a pair of parallel guide slots. (2) A pair of rods working in the slots and carrying at their end a frame to which is attached a tracing point and a pivoted carriage for the integrating wheel. (3) The integrating wheel for measuring the record.

The line joining the tracing point with the center of the base determines the radius-vector at any one instant. The axis of the integrating wheel is parallel with this line. Under these conditions it is easy to show mathematically that the record counted on the integrating wheel will be proportional to the product of the average radius-vector multiplied by the angle through which the radius-vector is carried. Hence by dividing the reading by the angle the mean radius-vector is obtained.

The instrument is graduated to give mean ordinate in linear inches, so that by applying the appropriate scale factor it may be used for all diagrams no matter what may be the character of the engineering quantity recorded. The limits for the movement of the tracing point are from a circle of diameter 1.5 inches as a minimum to a circle of diameter 10.5 inches as a maximum.

The form of instrument offered herewith is made in Switzerland by Amsler, Laffon & Company, and its accuracy will be found commensurate with that of the other types of planimeter made by the same firm. The American trade is being supplied by W. L. Durand, 242 Lafayette Avenue, Brooklyn, N. Y.

The Treibel Smoke Consumer.

This apparatus consists of a special form of grate admitting air to boiler and other furnaces at certain points, with a view to the prevention of smoke. It is of German origin, and has been fitted to about five hundred furnaces in that country. It consists of a special dead-plate perforated with holes for the admission of air, and a special system of air admission behind the bridge, and is dependent for its

action on these extra air supplies both at the front and at the back of the grate by means of natural draft. The air which passes through the holes in the dead-plate is admitted with the object of effecting the combustion of the coal at the front of the fire, as it is here that large quantities of smoke are often produced. As is well known, there is frequently a large quantity of unburned carbon in the form of smoke that passes over the ordinary furnace bridge and appears at the top of the chimney. The object of the Treibel fire-bridge is to prevent this waste, as the gases from the fire are thoroughly mixed with a further supply of air escaping at high temperature in a number of small streams from bent pipes arranged at the back of a hollow bridge. The aims of the designers of this furnace have been freedom from smoke with any fuel, great durability of all parts fitted, no motive power required, and a saving in coal of at least five per cent.

This apparatus is being handled by the Treibel Smoke-Combustion Company, 65 Bishopsgate, London, England.

Type G Lightning Arresters.

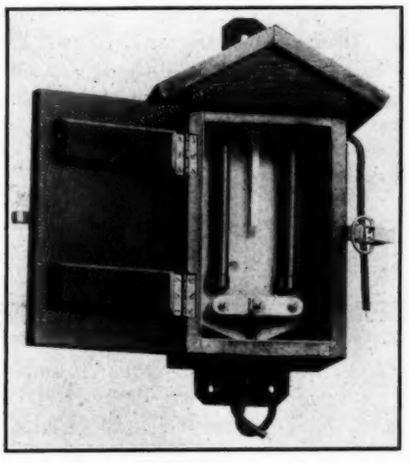
Lightning arresters must protect apparatus not only against disturbances due to visible atmospheric discharge but also against excessive potential stresses arising from various causes. These stresses may be caused by induction or surges on the line, or heavily charged clouds of rain or snow drifting across the line.

So many and varied are the causes of these disturbances and the different conditions under which apparatus must be protected that it is impossible to build a universal lightning arrester or one that will protect all apparatus on various kinds of circuits. It, therefore, becomes necessary to design arresters for different classes of service. The Westinghouse Electric & Manufacturing Company has placed on the market a new design in the type G lightning arrester for the protection of apparatus on alternating-current circuits having voltages not exceeding 2,500, and capacities not exceeding 1,000 kilowatts.

The type G arrester consists of a series of air gaps between non-arcing metal cylinders arranged in a row and connected in series with a graphite resistor. The cylinders and resistor forming the unit are mounted on a porcelain base which, in turn, is mounted within a wooden box as shown in the accompanying illustration. In a two-pole arrester, the unit is mounted on the back of the box, while in the three and four-pole arresters two units are used, one mounted on each side of the box.

The box is made of well-seasoned wood and is entirely weatherproof, enabling the arrester to be mounted outdoors in any exposed location desired.

On a two-wire circuit, the arrester has one wire connected to the top of each graphite resistor and the ground wire is connected to the middle gap of the series.



WESTINGHOUSE TYPE G LIGHTNING ARRESTER.

On four-wire circuits the same scheme of connections is used but two units are necessary and the connections of both are the same.

With three-wire circuits, two units are used, and the connections are the same as for four-pole circuits except that there are but three line connections instead of four.

The operation of the type G arrester is as follows: If an excessive potential is developed on the line, the abnormal charge of electricity flows to ground, relieving the line of the excessive stress. The resistance offered to the flow of current by the carbon resistor prevents an excessive current passing through the arrester to ground, and the tendency for a destructive power arc to follow the discharge arc is thus counteracted.

The type G arrester may be applied on distributing circuits carrying up to 1,000 kilowatts.

Toncan Metal.

The development of Toncan metal was undertaken to meet the demand for a black or galvanized sheet which would be moderate in price and have the highest corrosion-resisting qualities.

When the impurities—carbon, sulphur, phosphorus and manganese—become segregated in iron or steel, that is when they are not equally and evenly distributed throughout the metal, occurring in small spots or areas, an electrical current will be set up between these segregated points whenever the sheet, in which they are present, becomes covered with a film of moisture from the atmosphere. Due to differences in composition, some of these points of segregation become positive, others negative, which when connected by the film of moisture, set up numerous electrical batteries of greater or less energy according to the extent of the segregation, so that there are limitless numbers of small electrical batteries continually at work throughout the sheet. It is a well known fact that a current of electricity cannot be generated in a battery without destruction or dissolution taking place at the positive pole so that in any sheet iron or steel in which segregation has taken place and the surface of which through exposure to the atmosphere has become covered with a film of moisture, there are numerous small electrical batteries at work, at the positive poles of which the iron or steel is being destroyed, resulting in the form of corrosion known as pitting, a form with which we are all only too well acquainted. The more marked or strongly defined is the segregation, the stronger will be the electrical action; consequently the more rapid will be the destruction of the metal or sheet. On the other hand, the less well defined the segregation, the weaker or milder will be the electrical action, and consequently the life of the sheet will be longer. Again, in a well-made sheet of iron or steel in which the impurities have been properly incorporated and segregation reduced to a minimum, the electrical action will be so slight that pitting will not take place, but instead an even coating of rust will be formed over the entire surface of the sheet in such a way that the rust will itself become, to a great extent, a protective coating, greatly retarding the process of decomposition or rusting. It was for this

reason that the old-time iron sheets withstood so phenomenally the ravages of corrosion. It was not because they did not rust that caused them to last but the way in which they did rust, that made them so long lived.

It has generally been supposed that steel corrodes faster than iron, also that pitting is confined entirely to steel but this is by no means the case. Both iron and steel pit and corrode, and badly made iron lasts no better than badly made steel. The opposite of this is also true, namely, that properly made steel will withstand corrosion and pitting equally as well as iron, besides having far superior working qualities.

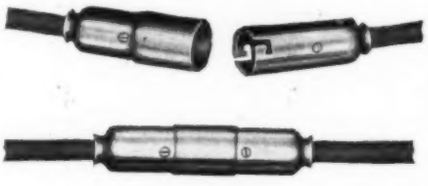
There may possibly be some question as to how electrolysis takes place in causing corrosion as regards the exact chemical reactions; but that electrolysis actually does take place, and that it is the true cause of corrosion cannot be successfully disputed. The fact that electrolysis does occur is proven conclusively by the ferroxyl test. The object of this test is to prove the theory of electrolysis by practical demonstration. The explanation of the test is this. At the poles of electrical batteries two forms of ions are found to be present, namely hydrogen ions and hydroxly ions. The hydrogen ions cluster around and indicate the positive pole. The hydroxyl ions in the same manner indicate the negative pole. The ferroxyl testing reagent is composed of certain indicators, the reactions of which when brought into contact with those two elements have been known for years. Ferroxyl is a weak acid and is of such a nature that, when brought in contact with hydroxyl ions, it at once produces a pink color, while potassium ferricyanide, when hydrogen ions are present causing iron to be dissolved or corroded, produces a blue reaction. Both of these chemicals are present in the gelatine mixture in which are imbedded the samples, the blue color indicating the positive poles where destruction or corrosion is taking place, the pink color indicating the negative poles. No piece of iron or steel has ever been found which when subjected to this test will not soonor or later develop the pink and blue reaction which can be easily witnessed.

The point involved then in the manufacture of iron or steel which is to resist corrosion, is to so combine and work up the raw materials that these electrical currents which cause corrosion will be of the mildest form, by avoiding excessive segregation.

The Stark Rolling Mill Company, Canton, O., has long recognized this fact, and for a considerable time has been carrying on a series of exhaustive tests and experiments to produce a material which would be reasonable in price and meet all requirements. The result is Toncan metal, a material which combines the essential qualities of high corrosion-resistance, ductility, and moderate cost. It is a galvanized ingot iron.

Cable Connectors for Automobile Lighting Circuits.

The cable connectors for automobile lighting circuits developed by the General Electric Company are designed to withstand all the severe conditions peculiar to the service. Each half is covered with a protective brass sleeve, as



CABLE CONNECTORS FOR AUTOMOBILE LIGHTING CIRCUITS.

shown in the illustrations, one end of which fits snugly over the brass armored cable. The two halves are held together by means of a standard Edison-Swan bayonet joint. This arrangement possesses a dual advantage—it not only effectually prevents the accidental separation of the connector and the consequent interruption of the circuit, but also permits of the ready uncoupling of any joint in the circuit and the prompt insertion of a trouble-lamp cable, in case of emergency. A dashboard receptacle and plug, the former designed to take the plug portion of the standard connector, is also available. The insulation consists of the toughest molded composition, and no effort or expense has been spared to make them most serviceable.

A Large Motor Order.

The General Electric Company has received an order for 300 four-motor car equipments from the Chicago Railways Company. This order calls for 1,200 thirty-five-horsepower, type GE-226 motors and 600 K-35 controllers with auxiliary equipment for the 300 cars.

A New Electric Fire-Damp Detector.

A new device for detecting fire damp in mines has just been invented by two young chemists, junior teachers in the Technical College at Sydney, Australia.

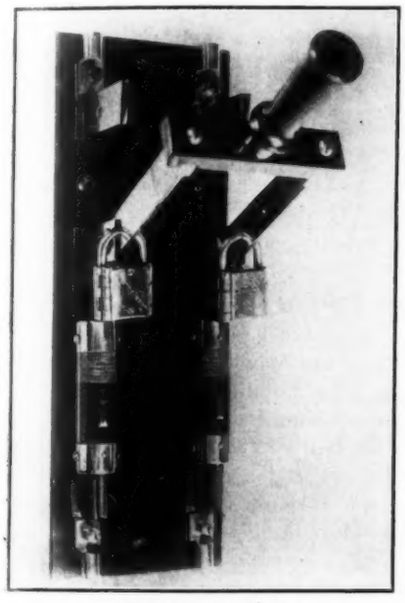
The new detector is a simple and portable apparatus, designed for the purpose of detecting and indicating the presence of fire damp and other dangerous gases in coal and other mines. Its warning is given either by a loud-sounding electric alarm bell, or by the flashing into view of a red incandescent light. The makers of this simple contrivance have based their procedure upon Graham's law of the diffusion of gases. Taking also Ansell's fire-damp detector as an additional starting point, the inventors have succeeded in producing an efficient instrument which an inspector or miner may carry in his hand and test with ease and certainty the air in any heading or working face.

The apparatus consists of merely a piece of glass tubing bent into U shape, with the lower curve flattened. One leg of the U has an ordinary shell funnel at its upper end, and the open mouth of this is covered by a thin disk of plaster of Paris, mixed thin, so that in drying it remains porous. The other leg is crowned by a small reservoir containing additional mercury, with a little glass tap to allow the metal to be run into the bent tube below as and when required. Through each lower leg there is passed a fine platinum wire, that of the funnel-crowned one being about half an inch below the level of the other, and immersed in mercury, which fills the bend of the U up to this level. Each wire is connected to the poles of an ordinary battery cell, and thence effective connection is made with either alarm bell or colored light.

What happens when the detector is brought into the presence of an admixture of gas and air is simply this: The foreign gas permeates the plaster of Paris seal and depresses the mercury column below. This naturally causes the mercury in the other leg of the U to rise and its rise brings it into contact with the platinum wire just above it. This light contact is sufficient to complete the circuit, and set either bell or danger light to work. So sensitive is the apparatus that, as shown by tests, it can be adjusted to give warning of the presence of such a small proportion as two per cent, or even less, of an undesirable gas.

A Locking Switch.

The necessity of protecting a man who is working on an electric line from the possibility of having the line made live while he is working upon it is one which frequently comes up. Where other circuits are served by the same feeder it may easily happen that someone interested in starting a machine or turning on lights may have reason to close the switch, and in ignorance of the danger to which he subjects the workman may close it, and an accident results. A simple device for application to a knife switch which enables the worker to protect himself from such danger has recently been described in the *Journal of Industrial Safety*, and is shown in the accompanying illustration. The knife blade is drilled with a hole which takes the hasp of a padlock, and the hole is so placed that when the hasp passes through it, and the lock is in place, the switch cannot be closed. The key of the lock is in the hands of the interested workman below it, and in the system illustrated the padlock has on it the name of the operative who has the key. The switch cannot be closed except by the holder of the key, or someone to whom he may give it. If two men are interested, it requires the consent and approval of both men before the switch can be shut.



SWITCH LOCKED.

Marking Time by Electricity.

A somewhat novel though not entirely new idea in electrical advertising is the New York Klok Monogram, a device which indicates the exact time in electric figures. The sign, which is made by Betts & Betts, is operated by a special flasher, controlled by a clock movement. Every sixty seconds the solenoid is actuated, starting the motor which drives the flasher. The relation of the mechanism to the clock movement is not affected by variations in the voltage, and the clock being accurately adjusted, the monogram will absolutely give the correct time.

Santo Duplex Stationary Vacuum Cleaner.

A new stationary-type duplex diaphragm vacuum cleaner, manufactured by the Keller Manufacturing Company, of Philadelphia, has recently been placed on the market.

It consists of three parts: Base, middle or operating portion, and upper or dust receptacle chamber. The base is a round conical casting twenty-three inches in diameter. The machine can be set on any level floor, requiring no screws or bolts to hold it down. The operating part consists of a lower pump chamber, above which is supported a similar chamber by means of four tubular columns, which also serve as the passageway for the air from the vacuum chamber to the lower pump.

Supported centrally between these two pump chambers on a substantial bracket or bridge is a one-quarter-horsepower motor designed especially for this machine. There are only five moving parts in the entire machine; the armature or rotor of the motor, the two eccentrics and the moving portion of the upper and lower pumps. The eccentrics are 180 degrees apart and the movements of each pump member five-eighths inch. The speed of the motor is 1,200 revolutions per minute, which gives 2,400 impulses per minute and a practically constant suction.

The pumps are similar to the Keller pump unit used in the Keller Santo portable machine, and consist of a saucer-shaped chamber closed by means of a circular leather diaphragm.

The dust chamber consists of a cylindrical steel shell mounted above the operating or pump portion and containing a removable dust bag.

The Keller Duplex stands forty inches high over all; weighs 180 pounds; has a capacity of forty-five cubic feet of free air per minute and produces a vacuum of eight inches to nine inches mercury gauge.

New Indirect-Lighting Fixture.

As is known to everyone, it is almost impossible to use the tungsten or Mazda lamp without in some way modifying its intense brilliancy either with frosted globes, frosted bowls or art glass. Indirect illumination in its recent developments, whereby the light is thrown by the proper appliances to the ceiling at the correct angle to reflect it back to the working plane, can be accomplished without more loss or waste than in protecting the eye by any of the above methods, and a very satisfactory light is given.

The National X-Ray Reflector Company, Chicago, Ill., is placing on the market a new unit for indirect lighting which has been designed especially for the new high-candlepower tungsten-filament lamps. As shown in the accompanying illustration the new unit is of simple and attractive design and is proportioned to give the best results. It is seventeen inches in diameter and eleven inches deep. The arms and chain are of cast brass. The unit is made in two sizes for a 250-watt and 400-watt lamp respectively.

NEW INDIRECT UNIT.

Boston Elevated Orders Car Bodies.

Contracts have been placed by the Boston Elevated for fifty all-steel car bodies equally divided between the St. Louis Car Company and the Standard Steel Car Company.

Recovering Tools Lost in Drilling.

One of the difficulties encountered in well drilling is the loss of tools. This may occur through worn cables, the imperfect attachment of the cable to the socket, neglect in setting up tools and the breakage of the tool itself. The recovery of the lost tool is often a problem. Electromagnets are sometimes used for fishing up.

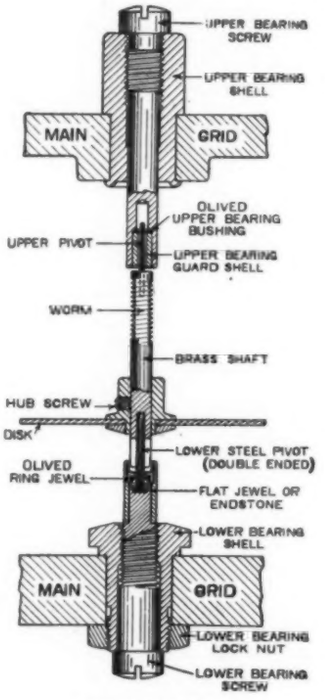
If the fallen object has been caught in the well wall above the oil or water or lies in a dry hole, its position may be determined by reflecting light into the well from a mirror. It was perhaps this operation which suggested the invention of a photographic device for determinations of this character. The device has not been used much in this country, although it seems that where a considerable amount of money depends on the early completion of a well whose drilling has been delayed by loss of tools it could be used to great advantage.

The device consists of a stereoscopic photographic apparatus, which is lowered to a point near the lost tool, light for the negative being furnished by an electric current carried by wires arranged in the camera.

An internally blackened bell-mouthed vessel, at the small upper end of which is fixed the stereoscopic camera, and at the sides of which are fixed two small electric lamps with shades reflecting the light downward, is attached to a sinker rod with guides. Incased in an air-tight chamber above the photographic device is an electric accumulator, which supplies the light, and interposed in the circuit is a small clock that can be regulated to produce contact at any desired time, switching on the light and opening the camera shutter at the same moment. Above this is placed a cylinder in which compressed air is stored, leading by minute tubes to the bell-mouthed photograpic vessel beneath. By a clever device a quick upward or downward motion of a few inches causes a disk, nearly equal in size to the well, working freely on the central spindle, to rise or fall and transmit a motion to a lever which actuates an air valve leading from the air vessel. The pressure of air must exceed the pressure due to the submergence of the apparatus in the liquid, and on the air valve being opened the fluid is displaced in the bell-mouthed vessel and an undisturbed view of the lost article is secured. After an exposure of one or two hours the air is shut off by a repetition of the before-mentioned jerk and the apparatus raised.

An Improved Type of Meter Bearing.

A type of bearing, standard in watch construction, but comparatively new in its application to integrating meters, which shows remarkably good results, is illustrated in the accompanying illustration, and has been adopted in the new type "H" Sangamo induction watt-hour meter. The steel pivot slips friction-tight into the lower end of a split-brass shaft. When one end of the steel pivot has become worn or injured, it can be easily withdrawn, reversed, and when pushed in, gives an entirely new pivot on the other end.



METER BEARING.

This pivot centers in a sapphire ring stone and end stone of the same construction as used in high-grade watch bearings. Any dust or foreign material collecting near the pivot by the rotative action of the pivot is carried to the side and away from the center of the flat jewel.

To those familiar with induction-meter operation it has long been known that there is a continual vibration of the moving element, caused by the shunt field. This vibration tends to pull the armature sidewise, and lift the pivot up against the curved surface of the jewel cup at each vibration. In the instant following this lifting, the pivot tends to drop back to the center of the cup, setting up a continuous pounding or drilling on the lower jewel, which eventually impairs or destroys its bearing surface. With the ring and end-stone bearing, it is impossible for the entire moving system to be lifted bodily off the end stone, so that while side play exists in the moving system the ring jewel and end stone prevent the pounding or drilling effect. A feature inherent to the ring and end-stone bearing is that the slight and necessary clearance between the shaft and ring jewel allows some play of the lower pivot on the end stone. This distributes the wear instead of concentrating and intensifying it at one point.

When combined with an electrical measuring system having a high ratio of torque to weight, this new bearing system permits the construction of a meter having a higher ratio of torque to friction and a greater life with accuracy than has heretofore seemed possible. This means decreased up-keep or maintenance charges.

New Building for the New York Edison Company.

Plans are being drawn for an eight-story office building for the New York Edison Company. The building is to be erected at 124 West Forty-second Street, where for a number of years the Second District offices were located. The old building will be torn down and the new structure started before the end of the summer.

The construction department of the Edison Company is sinking drills from the basement of the old building in search of bed rock, but at a distance of seventeen feet, reached last week, nothing but dirt had been encountered. The plans are being drawn by Burnham & Company, of Chicago. The plot on Forty-second Street is 25 by 100 feet.

The Second District offices are temporarily located at 245 West Forty-second Street. It is planned to have not only the offices of the district, but the entire contract and inspection departments located in the new building.

The General Electric Company has sold its patents on railway signal devices to the Union Switch & Signal Company of Pittsburg. This is taken as indication that the General Electric Company will retire from this field.

Current Electrical News

COMMISSION NEWS FROM NEW YORK.

(Special Correspondence.)

The Public Service Commission, Second District, will hold hearings at Albany and New York City next week. On Monday at Albany it will take up the application of the Rockland Light & Power Company for authority to issue $100,000 in five-per-cent mortgage bonds. With the proceeds the company intends to pay for extensions to its gas distributing system to the villages of South Nyack, Grand View and Piermont, purchase a gas holder and an auto truck, construct reservoir and cooling plant at its Orangeburg plant, and also install additional electric equipment.

On Thursday at its New York offices, the Commission will hold a further hearing on the complaints of various municipalities in Westchester County as to the prices of the Westchester Lighting Companies for gas and electricity.

An application has been received by the Public Service Commission, Second District, from the Wynantskill Hydro-Electric Company for permission to begin construction of an electric power plant at Wynantskill Creek in the town of Sand Lake, authority to exercise franchises within that town and permission to issue $7,500 capital stock. Within the vicinity of Wynantskill there are many villages and summer resorts which the company proposes to supply with electricity for light and power purposes. Some of the communities which it intends to serve are West Sand Lake, Snyder's Lake, Re.chard's Lake, Averill Park, Sand Lake, Crooked Lake and Burden Lake. At the present time electric service can only be secured by these communities from Troy. The company now has contracts for the supplying of over 400 lights.

The Oneida Railway Company has filed a petition with the Public Service Commission, Second District, for permission to exercise francnises for the building of its street surface railroad through Madison and Sconondoa streets in the city of Oneida, Madison county. At the present time this company is operating over the electrified West Shore Railroad between Utica, Oneida and Syracuse. Double tracks will be laid from Main and Madison streets to Cedar street, from whica point a single track will run along Madison Street to Sconondoa Street to a point where the tracks of the New York, Ontario & Western Railway cross the latter street. It is estimated that it will cost $25,000 to lay those tracks.

COMMISSION NEWS FROM WISCONSIN.

(Special Correspondence.)

A conference of the inspectors of service of the Commission has been held in Madison recently and the general service conditions in telephone, gas and electric plants throughout the state have been discussed. The action which shall be taken as against those plants which have failed to conform to the requirements of the public-utility law and the rules laid down by the Commission was discussed. In the past a number of plants have been required to appear before the Commission and explain their poor service conditions or show cause why they should not be proceeded against because of failure to meet the requirements of the law.

Complaints of poor service on the part of the Madison exchange of the Wisconsin Telephone Company have caused an exhaustive investigation to be made extending over a period of a number of weeks. The Commission has recently published a statement in regard to the conditions in Madison and this statement shows that the cause of the comparatively poor service has been the lack of equipment, especially of switchboard insufficiency. The report contains curves showing the speed of telephone operators in answering calls in Madison as compared with other plants in the state. The Telephone Company states that the present development in Madison is much larger than the company had expected and is much greater than any of the other exchanges of the company in the state. The present development in Madison is more than one telephone to each five persons in the city.

The legislature, which has recently adjourned, has materially increased the powers of the Commission and has very materially extended its authority and jurisdiction over utilities in the state. The stock and bond law has been strengthened in such manner as to leave the Commission in practical control of all issues in the future. The water powers of the state have been placed under the jurisdiction and control of the Commission and the owners of such powers or rights are required to surrender their franchises and take out permits from the Commission. In effect the law declares the water powers to be public utilities and subject to the Commission as are water, gas and electric utilities at persent.

COMMISSION NEWS FROM NEW JERSEY.

(Special Correspondence.)

The Board of Public Utility Commissioners, having been advised of several instances where contracts with public-utility corporations have been terminated on the allegation, by the utility, that the terms of the contracts constituted discriminations, has notified each public utility in the state to report to it all changes made in rates to customers receiving service at other than the regular schedule of rates, and also to report whenever any contract with a customer, at a special rate, is terminated and the charge to the customer is changed to the regular schedule of rates.

The Board has heard the complaint of F. C. Leaming, *et al.*, against the Trenton & Mercer County Traction Corporation, in regard to alleged discriminating and overcharge in rates of fare from the City of Trenton to the Borough of Pennington.

The Board has approved the proposed issue by the Middlesex Electric Light & Power Company of issue of its five-per-cent bonds to the amount of $5,000.

LIGHTING AND POWER.

(Special Correspondence.)

TIOGA, TEX.—L. A. Marshall has made application for an electric light franchise.

CUSTER, OKLA.—This city is about to begin the construction of an electric light plant.

BUTLER, OKLA.—W. K. Kise has been granted a twenty-year franchise for an electric light plant.

ROCK ISLAND, ILL.—A number of new tungsten ornamental street lights have been installed here.

PHOENIX, ARIZ.—An ornamental lighting system similar to the one in Warren, O., is proposed here.

ROODHOUSE, ILL.—The Chicago & Alton Railroad has established an electric lighting and power plant here. Z.

SOLOMON, KANS.—This city has arranged to issue $30,000 in bonds for the building of a light and water plant.

MILAN, ILL.—The People's Power Company of Rock Island is seeking a franchise for distribution lines in the village. Z.

LIBERTY, N. Y.—An all night schedule will be inaugurated when the contemplated installation of tungsten lamps is made.

CARSON CITY, NEV.—It has been decided to install electric light in place of numerous gas lamps in use on the capitol grounds.

CLINTON, MASS.—Extensive improvements in lighting are to be carried out here, many arcs being replaced by tungsten clusters.

SOUTHAMPTON, L. I.—The Suffolk Lighting & Heating Company has contracted to furnish the village with light for a term of three years.

CHESTER, PA.—A complete system of tungsten lighting for the city streets is being considered and specifications are in the course of preparation.

ZILLAH, WASH.—The Zillah Light & Water Company has been organized by local men for the purpose of supplying electric power to the city and to private consumers.

ST. PAUL, MINN.—The Consumers' Power Company, which controls the Northern Heating & Electric Company, is to expend $10,000,000 in improving its several plants in this state.

DENVER, COLO.—An ordinance providing for the operation of street lamps at the rate of $20.00 per lamp has been passed. Current will be supplied by the Denver Gas & Electric Company.

LINTON, IND.—An election has been called to vote on a proposition to either sell bonds to secure means to enlarge and improve the municipal electric light plant or to sell the plant to a private corporation. S.

GIBSON, ILL.—The Central Electric Light, Heat & Power Company has been incorporated to operate a light, heat and power plant. The capital is $100,000, and the incorporators are A. Hood, H. L. Clarke and J. Hood.

SAN FRANCISCO, CAL.—The California Consolidated Light & Power Company has filed articles of incorporation at Sacramento with a capital stock of $5,000,000. C. S. Goodrich, J. F. Piggott, T. E. Palmer, incorporators. A.

LEBANON, IND.—The Lebanon Electric Light Company and the Lebanon Heat Company have merged and will operate under one management. Both plants will be enlarged and improved. Some new machinery will be installed. S.

EXCELSIOR, MINN.—The Belle Plaine Lighting & Power

Company has commenced the construction of an electric light plant. The building will be 40 by 40 feet. A 145-horsepower Corliss engine and an eighty-kilowatt generator will be installed.

PAINE, O.—At an election upon the question of issuing bonds for the purpose of buying the electric light plant and installing a municipal water system the proposition was carried by a vote of 219 to 43. The purchase price of the lighting plant was fixed at $9,000. H.

FALLON, NEV.—The Government is arranging for the erection of a large hydroelectric plant at the new Lahonton dam, near this place, for operation of the Truckee-Carson project. Citizens of Fallon have presented a petition to the Government to sell power in the city. A.

PHOENIX, ARIZ.—The Water Users' Association is asking for bids for machinery for its new power house to be erected at Arizona Falls; estimated cost $30,000. Bids close August 6. Tenders will later be asked for the construction of the building. Charles A. Van der Veer, secretary. A.

NOBLESVILLE, IND.—The Wainwright Trust Company, of this city, has been appointed receiver of the White River Light & Power Company by Harry Sheridan, referee in bankruptcy. An application will soon be made to sell the plant and the request will be granted. The White River Light & Power Company owns the hydraulic dam and building two miles north of this city. S.

TWIN BRIDGES, MONT.—The Madison River Power Company plans to supply power for lighting to this city. It is proposed to start the line from the main power line at Ruby and run it to Alder, thence down the valley to Laurin and Sheridan, then on to Twin Bridges, where it will be terminated for the present. If the plans are adopted the construction work will be done as soon as possible.

PROVO, UTAH.—Directors of the Knight Power Company met recently and decided to build a power transmission line from the Murdock plant, above Heber, down Parley's canyon to Midvale, Salt Lake County. The work will cost about $50,000 and construction will be started at once. The purpose of the new line is to connect all of the Knight plants to increase the efficiency of the service.

SACRAMENTO, CAL.—The Citizens' Light & Power Company has closed a contract with the Great Western Power Company to supply power in blocks for local distribution. The Citizens' Light & Power Company will install a conduit system for lighting and power to cost $1,500,000, and will later build a power plant for its own generation. The company will soon file articles of incorporation with a capital stock of $5,000,000. George W. Peltier is president. A.

GRAND HAVEN, MICH.—The city of Grand Haven has asked the Grand Rapids-Muskegon Power Company to make a proposition to take over the municipal electric lighting plant and furnish service for municipal lighting and commercial purposes. The city has been doing a commercial business as well as doing the public lighting, and the plant is not large enough to furnish current for industrial purposes without a considerable new investment.

SAN FRANCISCO, CAL.—The Sacramento Valley Power Company, of which the Fleishhackers of this city are now in control, proposes to spend part of the $2,000,000 recently borrowed from the Anglo-California Trust Company in extensions of power lines and in the erection of new generating plants in the territory already occupied by them. The sum of $600,000 is to be expended immediately for betterments and $1,000,000 will be held in reserve for future improvements.

FT. DODGE, IOWA.—Bonds for the construction of a dam, to be used in connection with a hydroelectric plant, have been sold. An estimate which was made, showed that the total annual cost of operating a municipal dam, with electric machinery and auxiliary steam plant including settling basins, pumps, labor, supplies, maintenance and repairs, depreciation, and interest on the investment would be $33,910. The estimate also stated that the investment required for such an outfit would be $220,000.

NARRAGANSETT PIER, R. I.—The Narragansett Electric Lighting Company has placed an order with the General Electric Company for a twenty-seven-panel switchboard consisting of an instrument and controlling benchboard of twenty panels and an exciter and field-switchboard consisting of seven panels. This switchboard will control three 3,500-kilowatt and one 4,000-kilowatt, 2,300-volt, sixty-cycle turbo-generators. The equipment includes motor-operated oil switches, busbars, meters, instruments, etc.

CLEVELAND, O.—The Cuyahoga Light Company has sold its physical property to the Cleveland Electric Illuminating Company, which company will continue to supply all customers with service. The Cuyahoga Light Company was formed in 1907 and operated a small plant supplying a limited number of customers in the downtown business section. L. D. West, secretary and manager of the Cuyahoga Company, states that the property was sold some time ago, as the natural result of the idle duplication of capital in an effort to establish competition in a public utility.

MEMPHIS, TENN.—The holding company which is to succeed the American Cities Railway & Light Company, is reported to have gained control of the Consumers' Electric Light & Power Company, of New Orleans, thus adding $2,500,000 to its capital stock. The effect of the acquisition will be to give to the interests now dominating the New Orleans Railway & Light Company, the Memphis Street Railway Company, and other companies in the south, complete control of the business of supplying electricity for commercial and lighting purposes in New Orleans. A merger was effected some weeks ago by which the New Orleans Railway & Light Company was acquired by the holding company, which has been endeavoring for some time to secure additional capital and increase its power in the south. I.

NEZ PERCE, IDAHO.—A. Welch and R. B. Montague, of Portland, Ore., have secured possession of the Nez Perce Light & Power Company financed and controlled by Z. A. Johnson, president of the Nez Perce & Idaho Railroad, and which includes the Nez Perce water system, the high-tension line to Vollmer-Ilo, now in course of construction, the light and power franchise in Ilo, Nez Perce and Kamiah and the power plant and sawmill on Lolo Creek, two miles above Greer, where the power for the system is developed. The consideration was $70,000, C. H. Cunningham of Portland, who is to be superintendent for the new owners, taking charge. The purchasers, it is said, intend to develop the power plant at Lolo Creek to its full capacity and will at once enter the field in competition with the Grangeville Electric Light & Power Company, which now has a high-potential line into Cottonwood, where it recently purchased the local light and power system, and intends extending the power line from there into Vollmer.

TOLEDO, O.—The Common Pleas Court overruled the demurrer of the Toledo Railways & Light Company, in the action brought by the city to compel the company to operate under the new seven-cent electric lighting ordinance. As a result of the ruling of the court the company is now accepting payment at the new rate from its patrons, giving them credit for the amount paid but refusing to receipt in full. This method will be pursued pending further litigation and until a final decision by the court fixes the legal rate to be charged. The company in an answer attacks not only the ordinance of the city fixing the rate but also attacks the Ohio statutes which empower cities to regulate the rate of charge of lighting companies on the ground that such laws are unconstitutional. The company claims that both the ordinance and the statute of the state under which it was passed are confiscatory and unreasonable and if enforced will result in a loss to the company of at least $50,000 a year. Of the 4,000 consumers under contract in Toledo, about 2,000 use a monthly average of less than twenty kilowatt-hours, and 1,000 use less than ten kilowatt-hours, the average by all citizens of Toledo being twenty-three kilowatt-hours per month. H.

ELECTRIC RAILWAYS.

(Special Correspondence.)

GREENWOOD, S. C.—Cars on the local interurban road will probably be running by the first of December.

OAKLAND, CAL.—The Oakland Traction Company has been granted a franchise on East Sixteenth Street. A.

NEW HAVEN, CONN.—The trolley line between this city and Guilford is near completion and will probably be in operation by the middle of August.

DULUTH, MINN—A franchise has been granted to the Suburban Traction Company, which proposes to build a line connecting with the Brooks-Scanlon Road

ST. PAUL, MINN.—The Board of Aldermen has ordered the construction, by the street railway company, of twelve blocks of line from Burns Avenue to Earl Street.

VIRGINIA, MINN.—Construction will be completed within five months on the electric line thirty-six miles long, to connect Virginia, Gilbert, Hibbing, Buhl, Chisholm, and Mountain Tron. C.

DULUTH, MINN.—The Suburban Traction Company is calling for bids for the construction of 5.3 miles of road between Duluth Heights and the Pike Lake highway, to be received up to July 24. D. A. Reed, engineer. C.

FAIRMONT, W. VA.—The Morgantown Interurban Railway Company has been incorporated for the purpose of constructing a trolley line from Fairmont to Waynesburg by way of Morgantown and Point Marion

FRESNO, CAL.—The Fresno, Coalinga & Monterey Railway has been incorporated with a capital of $4,000,000. A road will be constructed from Fresno to Coalinga, and From Monterey to Hollister. Albert Albrecht is interested. A.

SHELBURNE FALLS, MASS.—Surveyors are at work on the proposed extension of the Shelburne Falls and Colrain Street railroad from Colrain to Wilmington, Vt. It is expected that the extension will greatly benefit this village from a business standpoint.

BEATRICE, NEB.—It is reported that a number of local capitalists will soon organize a company here to establish a street car line in this city. It is said that about $30,000 has been subscribed, and that as soon as $100,000 is secured a franchise will be asked for.

CANAAN, CONN.—The Berkshire Street Railway Company recently became the owner of the franchise for a trolley line between this place and the Massachusetts state line, to connect with a line being built from Ashley Falls, Mass. The nominal holders

of the franchise previous to its transfer were Henry J. Roraback and S. F. Eddy. Work on the construction of the line, it is understood, will be pushed as rapidly as possible.

TEMPLE, TEX.—The lines of the local street car system are to be extended to the Tal-Coe addition.

WAYNESBURG, PA.—The first work towards the building of the street car line from Waynesburg to Blacksville, W. Va., was begun recently.

PEKIN, ILL.—Material has arrived for the Pekin & Petersburg Interurban Railroad and construction work will be pushed to completion as rapidly as possible.

BRISTOL, MASS.—The Bristol & Plainville Tramway Company has placed an order with the General Electric Company covering a complete power plant equipment which includes two 937-kilovolt-ampere horizontal turbine generator units, switchboard, rotary converters, motor-driven and turbine-driven exciters, etc.

NEW ORLEANS, LA.—The franchise for building a street railway line on Newton Street, from Teche Street to Pacific Avenue, Elmira Avenue, from Newton to Opelousas, Opelousas, from Elmira to Pacific Avenue, to connect with existing tracks, in Algiers, has been sold to the Algiers Railway & Lighting Company.

MORRIS, ILL.—H. H. Evans, of Aurora, has deposited $50,000 in banks at Morris and Yorkville as a guarantee that the Yorkville-Morris line which will be known as the Fox & Illinois Union line will be completed. When $50,000 has been expended for construction work the deposit may be withdrawn for further extension of the line. Z.

BRISTOL, CONN.—The Bristol & Plainville Tramway Company, the only independent local trolley system in the state, operating between this borough, Plainville and Terryville, is to increase its power-plant capacity. Two 1,000-horsepower steam turbines will replace the four reciprocating engines and the many generators now in use.

MORGANTOWN, W. VA.—At a meeting of the promoters of the Morgantown & Mount Morris Trolley Company it was stated that nearly all the right of way had been secured and that the balance would be obtained in a short time. Funds for actual construction work have been subscribed and the road will probably be built within a year.

BRIDGEPORT, CONN.—Work on the construction of the Bridgeport & Danbury Electric Railway Company's line in the town of Trumbull is progressing rapidly, and the force of workmen has completed a mile of the roadbed and the ties and rails are in position. The line will run northward, in the direction of Monroe, across the southwestern corner of which town it will pass as it approaches Newtown.

KOKOMO, IND.—Electric cars operated by the Kokomo, Frankfort & Western Traction Company will probably be running between this city and Frankfort by January 1. The new line will take a southwesterly course, pass through the towns of West Middleton, Russiaville, Forest, Michigantown and one or two other places, and finally enter Frankfort from the northeast. The length of the line, it is understood, will be about twenty-six miles.

SHARON, PA.—The Republic Railway & Light Company, recently incorporated in New Jersey with a capital of $17,000,000 to take over the stock and holdings of the Mahoning & Shenango Valley Railway & Light Company, will expend $3,000,000 in improving and extending the lines in this section. The local power house will also be enlarged and new equipment installed. All franchises in Pennsylvania are perpetual. The Ohio franchise is twenty-five years with about twenty years to run.

EUGENE, ORE.—Work has been started on the survey of the right of way of the Portland, Eugene & Eastern Railway. Right-of-way deeds have already been filed covering the entire distance between Eugene and Monroe, twenty-three miles from here, at which point the survey connects with the line of the Corvallis & Alsea Railroad, which was acquired several months ago by the Welch interests. Mr. Welch has promised to have cars running from Eugene to Corvallis by January 1, 1912.

NEW ORLEANS, LA.—The Southwestern Traction & Power Company will, in a short time, begin the construction of its interurban trolley line from Spanish Lake to Jeanerette via New Iberia. The company expects to be occupied from six to nine months in the construction of the line, and to have cars running within the year. This line, seventeen miles in length, will be the first division of what is expected to be an interurban service from Spanish Lake to Morgan City, a total distance of sixty-six miles. F. W. Crosby is president of the company and Henry A. Montz is the vice-president.

MANHATTAN, KANS.—The Manhattan Interurban Railroad Company is planning to build an interurban line from Manhattan to Fort Riley. At the latter point it will connect with the line which now connects Fort Riley and Junction City making a continuous line from Manhattan to Junction City, a distance of twenty-four miles. The Manhattan company has been granted permission by the Public Utilities Commission recently to vote $200,000 in preferred stock for this purpose. It is said that the plan is ultimately, to connect up Manhattan, Junction City, Abilene, Solomon, Salina and all intermediate towns along the Smoky Hill River with an interurban system.

TELEPHONE AND TELEGRAPH.

(Special Correspondence.)

GEYSER, MONT.—The Bell Telephone Company is constructing a line to Stanford. C.

ELY, MINN.—The Council is considering the installation of a Gamewell fire-alarm system. C.

FORDYCE, ARK.—The Southern Telephone Company has authorized a bond issue of $300,000.

SLEEPY EYE, MINN.—The Sleepy Eye Rural Telephone Company will build an exchange here. C.

VENICE, CAL.—The Home Telephone Company plans for the erection of a new central station. A.

LA CROSSE, WIS.—A new building costing $25,000 is being erected by the La Crosse Telephone Company. C.

RED GRANITE, WIS.—The Red Granite Telephone Company has been incorporated with a capital stock of $4,000.

BRENHAM, TEX.—The Brenham & Welcome Telephone Company has been organized to build lines out of this city.

LOS ANGELES HARBOR, CAL.—The Pacific Telephone & Telegraph Company has completed its new exchange building. A.

DUBLIN, GA.—The Carey Stephensville Telephone Company has been incorporated with a capital of $12,000 by W. F. Colley.

MANDAN, N. D.—The North Dakota Telephone Company is arranging for new telephone lines both north and south of this city.

PRESCOTT, ARK.—J. B. Hampton and others have purchased the telephone exchange from the Southwest Arkansas Telephone Company. P.

GRINNELL, IOWA.—The Interior Telephone Company has announced its intention to carry out in the near future a number of improvements.

CEDARHOME, WASH.—The Cedarhome Telephone Company has been incorporated with a capital of $10,000 by Peter Hanson and N. Nielson.

HARDIN, MONT.—R. V. McComb is about to commence the construction of a telephone line to connect with the long-distance circuit at Custer. C.

VENTURA, CAL.—The Pacific Telephone & Telegraph Company has commenced construction work on an additional line from Ventura to Oxnard.

FARGO, N. D.—The Northwestern Telephone Exchange Company is planning extensive improvements, including the installation of a conduit system. C.

VIRGINIA, ILL.—Stockholders of the Cass County Telephone Company will meet August 15 to vote upon the proposition to decrease the capital stock. Z.

OAKESDALE, WASH.—The Oakesdale Home Telephone Company has been incorporated with a capital stock of $10,000, by A. Woodward and Edward Roberts.

PALACIOS, TEX.—The Coast Telephone Company was recently incorporated with a capital of $35,000. The incorporators are T. J. Hardey, T. J. Pool and H. W. Dean.

SAN FRANCISCO, CAL.—The Postal Telegraph & Cable Company has completed its telephone line between here and Reno, Nev. The company has made a reduction in rates. A.

AMBROSE, N. D.—The Divide County Farmers' Telephone Company will erect a central exchange for a system with which it proposed to cover every section of the county. C.

WILLOWS, CAL.—The Pacific States Telephone & Telegraph Company plans for the installation of a new exchange station. About $15,000 will be expended for equipment.

NAPA, CAL.—A twenty-year franchise for a telephone line near St. Helena has been granted to W. H. Simmons. H. Voorman DuBois has also been granted a twenty-year franchise for a telephone line near Napa along the County roads.

BURLINGTON, WIS.—The Wisconsin Telephone Company is running new lines from here to Brown's Lake, and from Milwaukee and Racine to Burlington and Lake Geneva.

WILLOWS, CAL.—The California National Forest has completed its telephone line to Covelo, Mendocino County, 110 miles. This is the first line to be constructed across the Coast Range Mountains. A.

TACOMA, WASH.—The Sunset Telephone Company has let the contracts for two new substations in this city; one on Seventh and Proctor Streets, which will cost $25,000, and a smaller station in the South end of the city.

PETERSBURG, ILL.—The People's Telephone & Telegraph Company of Menard County has been incorporated with capital stock of $100,000. The incorporators are D. W. Frackelton, A. J. Parsons and Henry H. Colby, all of Petersburg.

BOONVILLE, N. Y.—A certificate of incorporation has been filed by the stockholders of the Peoples Mutual Telephone Company. The capital is $5,000 and the directors are Eugene H. Hayes, Frank A. Barret, Andrew Hurlout and others, all of this place.

ELECTRICAL SECURITIES.

A. G. Edwards & Sons of New York, offer at a price to yield about six per cent $500,000 Waco (Texas) Street Railway Company first-mortgage six-per-cent bonds, dated June 1, 1911, and due June 1, 1916. Bonds are redeemable at par and interest on thirty days' notice.

The Toronto Street Railway Company will increase its capital stock from $8,000,000 to $12,000,000. Of this, $1,000,000 will be distributed among the stockholders as a dividend, $2,000,000 will be offered to stockholders at par, and the remainder held in the treasury. The dividend has been increased from seven per cent to eight per cent per annum.

Stockholders of the United States Light & Heating Company have approved a proposition to change the par value of the shares of the capital stock of the company from $10 a share to $100 a share. There is no change in the total capitalization, so that hereafter capital stock will be divided into 25,000 preferred and 150,000 common shares of par value of $100.

DIVIDENDS.

Butte Electric & Power Company; preferred dividend of one and one-quarter per cent, payable August 1.

Cambridge (Mass.) Electric Light Company; quarterly dividend of $3 a share, thus placing the stock on a twelve per cent basis, against a former rate of ten per cent.

Columbus Railway Company; preferred quarterly dividend of one and one-quarter per cent, payable August 1.

East St. Louis & Suburban Railway Company; preferred quarterly dividend of one and one-quarter per cent, payable August 1.

Harrisburg Traction Company; a dividend of three per cent, payable August 1.

Havana Electric Company; common quarterly dividend of one and one-half per cent, and preferred of one and one-half per cent, payable August 12.

Home Telephone Company, Albion; quarterly dividend of one per cent, payable July 20.

Jacksonville Traction Company; common dividend of $1.75 per share, and preferred of $1.50 per share, payable August 1.

Lincoln Traction Company; preferred quarterly dividend of one and one-half per cent, payable August 1.

Lewiston, Augusta & Waterville Railway Company; quarterly dividend of one and one-half per cent, payable August 1.

Lowell Electric Light Company; quarterly dividend of $2 per share, payable August 1.

Michigan State Telephone Company; preferred quarterly dividend of one and one-half per cent payable August 1.

Milwaukee Electric Company; preferred quarterly dividend of one and one-half per cent, payable July 31.

CLOSING BID PRICES FOR ELECTRICAL SECURITIES ON THE LEADING EXCHANGES AS COMPARED WITH THE PREVIOUS WEEK.

NEW YORK.

	July 24	July 17
Allis-Chalmers common	8	8
Allis-Chalmers preferred	28½	28¼
Amalgamated Copper	69⅛	68¾
American Tel. & Cable	*78	*78
American Tel. & Tel.	136⅝	138
Brooklyn Rapid Transit	82¾	83⅛
General Electric	162	161¾
Interborough-Metropolitan common	17⅞	18
Interborough-Metropolitan preferred	51	52¼
Kings County Electric	129	129
Mackay Companies (Postal Telegraph and Cables) common	86	87½
Mackay Companies (Postal Telegraph and Cables) preferred	74⅛	74¼
Manhattan Elevated	138	135
Metropolitan Street Railway	*18	*18
New York & New Jersey Telephone	103	103
Pacific Tel. & Tel.	47	46½
U. S. Steel common	80	78⅞
U. S. Steel preferred	118¾	118¼
Western Union	81⅜	81⅝
Westinghouse common	75½	75⅛
Westinghouse preferred	*111	*111

BOSTON.

	July 24.	July 17
American Tel and Tel	136⅝	138
Edison Elec. Illuminating	285	281
General Electric	162½	161½
Massachusetts Electric common	23	23½
Massachusetts Electric preferred	93¾	94¾
New England Telephone	145	145
Western Tel. & Tel. common	21¼	20
Western Tel. & Tel. preferred	97	95

PHILADELPHIA.

	July 24	July 17
American Railways	44	43¾
Electric Company of America	12⅛	12⅛
Electric Storage Battery common	55½	54
Electric Storage Battery preferred	55½	54
Philadelphia Electric	17¾	17⅞
Philadelphia Rapid Transit	22½	22¼
Philadelphia Traction	86¾	87½
Union Traction	51¾	52

CHICAGO.

	July 24	July 17
Chicago Railways, Series 1	87½	87½
Chicago Railways, Series 2	27¼	27¾
Chicago Subway	3⅝	3⅝
Chicago Telephone	123	122
Commonwealth Edison	135	137¼
Chicago Elevated common	28½	28½
Chicago Elevated preferred	92½	92½
National Carbon common	112	112
National Carbon preferred	118	118

PERSONAL MENTION.

LEO P. BAIRD has been elected president of the Abingdon Light & Power Company, of Abingdon, Ill., to succeed Strawther Givens, resigned.

GEORGE BLAGDEN and P. A. S. FRANKLIN have been elected directors of the New York & Queens Electric Light & Power Company, succeeding J. C. Havemeyer and J. F. Eagle, who resigned.

FRANK B. KNIGHT, who is special agent in charge of publicity of the Southwestern Telephone & Telegraph Company, Dallas, Tex., sailed recently for Paris. Mr. Knight expects to return to this country about November 1.

W. R. HEAGLER has resigned as general manager and chief engineer of the Alton, Jacksonville & Peoria Interurban Railway. O. W. Pegee has been made chief engineer and the duties of general manager will be performed jointly by E. M. Davis and Arthur Davis.

W. S. HEGER has resigned as manager of the San Francisco and Los Angeles offices of the Allis-Chalmers Company, his duties being assumed by Fred L. Webster, who, for the past three years, has been manager of the Seattle Office. M. C. Miller, from Milwaukee, assistant to the president of the Allis-Chalmers Company has been in San Francisco on business in connection with the change of managers of the Pacific Coast territory of his company.

WILLIAM PENN HAZELTINE, who for many years has been the electrical superintendent of the Lynn Gas & Electric Company, died July 18, in Lynn, Mass., after an illness of several months. He was born in Hilliker, N. H., and for a time was principal of the evening drawing school in Lynn. He was one of the first constructing engineers of the Thompson-Houston Electrical Company, and in 1890 became connected with the Lynn company. A widow and four children survive him.

PUTNAM A. BATES, the well-known consulting engineer of New York City, has been appointed Director of Agricultural Engineering and Machinery Exhibits for the American Land and Irrigation Exposition, which is to be held in Madison Square Garden, New York, next November. This exposition has on its advisory and governing board the governors of over twenty states and the presidents of several of the largest railroad systems, including New York Central, Pennsylvania, Burlington and Union Pacific. It is a long time since New York City has had an exposition of this character, and the railroads and states are going to seize the opportunity to emphasize in every way the importance of agricultural interests. It is the intention of Mr. Bates to give particular attention in his department to electrical applications which are now multiplying so rapidly in the rural districts. At the present moment he is engaged with T. C. Martin in the issuance of a series of articles in a popular periodical on the "Utilization of Central-Station Circuits for Country Properties and Small Farms," within striking distance of central power houses.

D. A. HEGARTY, vice-president, treasurer and general manager of the Little Rock Railway & Electric Company, of Little Rock, Ark., has resigned to accept the position of general manager of the New Orleans Railway & Light Co. He will assume his new duties August 1. Mr. Hegarty is a graduate of the University of Pennsylvania, becoming, after his graduation, assistant engineer in the construction department of the Pennsylvania Railroad. Subsequently he was general manager and chief engineer of the Philadelphia Traction System of Philadelphia before the consolidation, and was afterward manager and chief engineer of the Norfolk Railway & Light Company of Norfolk, Va., going from there to New York to become general manager and chief engineer of the Railways Company General. Mr. Hegarty is prominent in electrical and railway associations being a member of the Committee of City Rules of the Transportation and Traffic Department of the American Electric Railway Association, member of the Committee on Standards of the National Electric Light Association, member of the Committee on Standards of the Engineering Association, U. S. A., member of the American Society of Municipal Improvements, director of the Engineers' Club of Philadelphia. He is also the organizer and past president of the Arkansas Association of Public Utility Operators.

NEW INCORPORATIONS.

OMAHA, NEB.—The Schietzel Electric Shot-Firing Machine Company has been incorporated with a capital stock of $100,000.

LA CROSSE, WIS.—The Universal Automatic Electric Signaling Company has been incorporated with a capital stock of $28,000.

KANSAS CITY, MO.—The Peerless Electric Sign Company has been incorporated with capital stock of $35,000. The incorporators are John C. Meredith, W. R. Bump and F. C. Sharon. Z.

ROCHESTER, N. Y.—The Walter T. Goddard Company was recently incorporated with a capital of $5,000 to manufacture electrical machinery, etc. The incorporators are W. T. Goddard, Edna C. Goddard and Janet M. Cook, all of Rochester.

NEW YORK, N. Y.—The Wilson Storage Battery Company has been incorporated with a capital stock of $200,000 to manufacture storage batteries, etc. The incorporators are George N. Orcutt, Frederick D. Underwood, John C. Stuart and T. Rumney.

SPRINGFIELD, ILL.—Articles of incorporation have been issued to the Springfield Northwestern Interurban Company which,

with a capital stock of $15,000, proposes to build an interurban line between Springfield and Greenview in Menard County by way of Athens with lines running west from Athens to Petersburg and north from Athens to Mason City. The incorporators are Homer J. Tice, Greenview; Richard Y. Kincaid, Athens; and Samuel E. Prather, George L. Harnsberger and W. F. Workman, all of Springfield. Z.

PROPOSALS.

LEAD-COVERED CABLE.—The Bureau of Supplies and Accounts, Navy Department, Washington, D. C., will open bids in Washington on August 8, for 2,000 feet of lead-covered cable for delivery at the Brooklyn Navy Yard. Specifications may be obtained from the above by referring to Schedule No. 3781.

ELECTRICALLY DRIVEN SUCTION DREDGE.—The Bureau of Yards and Docks, Navy Department, Washington, D. C., will receive proposals until 11 o'clock, August 12, 1911, for a twelve-inch electrically driven suction dredge for the United States Navy Yard, Charleston, S. C. Plans and specifications can be obtained on application to the Bureau of Yards and Docks or to the Commandant of the above mentioned navy yard.

WIRING.—The office of the Supervising Architect, Washington, D. C., will receive sealed bids for doing electrical work in connection with the construction and remodeling of postoffices in the following places; bids closing on the date given below:

Work.	Place.	Date.
Vacuum cleaning system	New York, N. Y.	August 16
Wiring, conduits and fixtures	Mineral Wells, Tex.	August 17
Vacuum cleaning system	Los Angeles, Cal.	August 21
Wiring, conduits and fixtures	Monroe, Mich.	August 29
Wiring, conduits and fixtures	Wallingford, Conn.	August 28

Drawings and specifications may be obtained from the custodian at the postoffice site or at the office of the Supervising Architect.

INDUSTRIAL ITEMS.

VAN RENSSELAER LANSINGH, ROBERT KELLY, JR., announce that their address has been changed from No. 50 Church Street, New York, to No. 16-18 East Fortieth Street.

OTIS & SQUIRES, Pacific Coast agents for the Cutler-Hammer Manufacturing Company, have established a branch office in Portland, Ore. This office, in charge of G. L. Priest, is located at No. 229 Sherlock Building.

THE ESTERLINE COMPANY, Lafayette, Ind., advertises the Matchless electric lighting and ignition system in a recently distributed folder. The generator used in connection with this system is of the permanent magnet type.

THE GENERAL VEHICLE COMPANY, Long Island City, N. Y., calls attention in the July number of Elec-Tricks, to an order for fifteen additional electric trucks for government service in Manila. It is stated that this is the fourth repeat order.

JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, N. J., in the July issue of *Graphite*, reproduces an interesting article by L. H. Snyder, entitled, "Graphite and Some of its Uses ." This is only one of the many interesting features of this number.

THE NORTHWEST ELECTRICAL EQUIPMENT COMPANY, Portland, Ore., has moved from its office at No. 530 Lumber Exchange Building, to No. 7 North First Street. W. H. Banes, formerly with the J. C. English Company, is manager of the company.

THE ROESSLER & HASSLACHER CHEMICAL COMPANY, 100 William Street, New York, is distributing a revised price list pertaining to its products. Special atention is called to the prices of the following: acetone, arsenic white, carbolic acid, platinum salts and tin oxide.

THE WAGNER ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., has prepared a bulletin descriptive of its new alternating-current rectifier. This instrument is suitable for charging small storage bateries from alternating-current lighting or power circuits.

THE MUNNING-LOEB COMPANY, Matawan, N. J., was recently organized by A. P. Munning and W. L. Loeb, for the design and manufacture of electroplating and buffing equipment and supplies. Among other things the company will pay special attention to the manufacture of anodes, brushes, dynamos, nickel salts and rouges.

THE BEARDSLEE CHANDELIER MANUFACTURING COMPANY, Chicago, Ill., illustrates, in "A Book of New Ideas," which was recently issued, a large number of graceful and artistic electric fixtures. Another publication, "Light and Art in the Home," pays especial attention to descriptions of the artistic features of the company's product.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., is selling a new fan-motor warmth blast which has a protected heating element attached to the blade guard of the fan motor. The air blown through the heated coils, which is supplied with current from the motor lead, is raised to a sufficient temperature to warm cold rooms, dry wet hair or keep a show window free from frost.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., has prepared and distributed a very attractive full-color poster for central-station companies and dealers in electric automobile supplies. The poster which is worded: "Don't forget the 'little' charging set when you buy her that little electric," refers to the company's runabout-type mercury-arc-rectifier battery-charging set for those wishing to do their charging at home.

THE BRISTOL COMPANY, Waterbury, Conn., is distributing an illustrated bulletin, which is a condensed general catalog of Bristol instruments for pressure, temperature, electrical measurements, etc. Only the most important of the many varieties of the company's instruments are illustrated in the present publication, which will be supplemented by separate catalogs or bulletins providing more complete information about the various lines.

THE RICHARDSON-PHENIX COMPANY, of Milwaukee, Wis., manufacturers of appliances for lubrication, announces that it has opened a new engineering sales office in Philadelphia, Pa., located in the Real Estate Trust Building. This office is under the management of J. F. McIndoe, who has had several years' experience in general machinery lubrication. Any questions pertaining to this subject will be given prompt and careful attention at this office.

THE MORRIS IRON COMPANY, of No. 86 West Street, New York City, reports an increased rather than diminished business in the ornamental lighting field, and although they manufacture a large number of designs the principal calls are for five-light standards with four inverted and one upright globe, arc poles or luminous or magnetite arc lamps, and combination trolley and lighting poles. Recent orders include five-light standards to be installed at Marshal, Mich., and Richmond, Va.

THE NATIONAL ELECTRIC LAMP ASSOCIATION, Cleveland, O., devotes bulletin No. 16 to a description of Mazda incandescent street lighting. A discussion of the requisites of good lighting, and directions as to proper arrangement of units are of especial interest. A number of views of the standards used give an excellent idea of their appearance. Bulletin No. 17 deals with the economical operation of incandescent lamps from the standpoint of both the consumer and the central station.

THE CUTLER-HAMMER MANUFACTURING COMPANY, Milwaukee, Wis., held its fourth annual outing at Waukesha Beach on Saturday, July 22. The special trains left the terminal building at Milwaukee at 8:30 in the morning, leaving at different times for the return trip in the evening. There was a baseball game between the office employees and the shop men, a basket lunch guessing games for the ladies and a number of athletic contests, prizes being awarded to the successful ones in each event.

THE UNIVERSAL ELECTRIC STAGE LIGHTING COMPANY, New York, N. Y., of which Kliegel Brothers are the proprietors, has distributed a pocket catalog of theater and show equipments. Attention is especially directed to a reprint of the present "National Electrical Code on Theater Wiring," which comprises a set of rules that have been universally adopted. The Kliegel pocket catalog includes an open diary to December, 1912, and in addition lists electrical apparatus, effects and supplies.

THE PETERSON ENGINEERING COMPANY, lubrication engineers with offices in the Hudson Terminal Building, New York, and First National Bank Building, Chicago, and branch offices located throughout the United States, announce that they have taken over from the American Engineering & Manufacturing Company, Inc., of Philadelphia, Pa., the exclusive sale of the Imperial elevator-guide lubricator, manufactured by the latter company. This device will now be known as the Economy elevator-guide lubricator.

THE CONDUIT WIRING MACHINE COMPANY, 42 Hudson Street, New York City, exhibited a very interesting and practical device for fishing wires through rigid and flexible conduit at the convention of the National Electrical Contractors' Association at Niagara Falls last week. The machine was demonstrated by Wm. F. Wendell, the inventor. The apparatus is portable, light in weight, and the method of operation depends upon the reciprocating action of two coiled reels of steel fish-wire. The lower coil receives the fish wire from the upper coil, which is in the same plane of rotation, and the upper coil maintains sufficient pressure to guide the fish wire through the grooves leading from the lower coil. A flexible armored snake is attached directly to the groove leading from the lower coil and this snake is inserted two or three feet into the conduit to be fished. In the demonstration Mr. Wendell had laid out a nest of three-quarter inch rigid conduit containing nine bends, the run being both horizontal and vertical, and although the apparatus was not in prime condition, owing to rather crude work on the part of the model makers, the apparatus fished this nest of conduit very handily. Full information respecting this machine may be had by writing to the company.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, Pitsburgh, Pa., has issued folder No. 4201, "Charging the Automobile Battery with Westinghouse-Cooper Hewitt Rectifier Outfits." The folder is well illustrated and describes outfits and accessories. A small folder, No. 4206, on Westinghouse automatic section insulators has also been sent out. The folder gives the applications with style numbers, sizes of wire, and cross-section views, and will be sent to anyone interested on application. Folders 4204 and 4205 are also of interest. No. 4204 is entitled "Telephone Battery Charging with Westinghouse-Cooper Hewitt Rectifier Outfits," and No. 4205 is entitled "The Right Light," and covers the use of the rectified-current arc lamp with moving-picture machines.

THE ART BRASS & FIXTURE MANUFACTURING COMPANY, of Pittsburg, announces its large and fully equipped estab

lishment for the manufacture and sale of brass stampings, turnings and fixture parts of all kinds, complete line of combination gas and electric fixtures, art brass specialties, gas and electric portables, steel, aluminum and enameled shades. The company's offices and works are at McKee's Rocks, Pa., and it has a capital stock of $100,000, fully paid. Its depository is the Union Trust Company, of Pittsburg. The officers and directors are: Lawrence M. Fluhart, president. Scott Hayes, vice-president; Livingston R. Jeffords, treasurer; John A. Irwin, secretary; Carroll P. Davis, counsel. Earle V. Hennecke has been made general sales manager of the company. Mr. Hennecke is one of the best known men in the electrical fixture line and has for a long time been very favorably connected with the industry. He made a big reputation as a salesman with the Brilliant Electric Company, later on becoming connected with the Tungstolier Company. For the last three or four years, Mr. Hennecke has been representing the Faries Manufacturing Company. He knows the fixture business from the ground up, and, backed by the strong interests with which he is now connected, he will prove a big factor in this business. The company has prepared a complete catalog, which will be furnished to those interested upon request.

DATES AHEAD.

Indiana Electric Light Association. Annual convention, South Bend, Ind., August 23 and 24.

Old Time Telegraphers' and Historical Association and the United States Military Telegraph Corps. Thirtieth annual reunion, Atlantic City, N. J., September 5-7.

International Association of Municipal Electricians. Annual convention, St. Paul, Minn., September 12-15.

International Municipal Congress and Exposition. Chicago, Ill., September 18-30.

American Electrochemical Society. Twentieth general meeting, Toronto, Canada, September 21-23.

Illuminating Engineering Society. Annual convention, Chicago, Ill., September 25-27.

American Mining Congress. Thirteenth annual meeting, Chicago, Ill., September 25-30.

American Electric Railway Association. Annual convention, Atlantic City, N. J., October 9-13.

Association of Railway Electrical Engineers. Annual convention, La Salle Hotel, Chicago, November 6-10.

RECORD OF ELECTRICAL PATENTS.

Issued (United States Patent Office) July 18, 1911.

997,953. ELECTRIC GARMENT PRESSER. Jacob Bloch, Cincinnati, O. Filed Oct. 17, 1910. A fixed horizontal tube and a parallel movable tube are each provided with co-acting presser surfaces. Each tube contains an incandescent lamp for heating it.

997,954. ELECTRIC PRESSER FOR NECKTIES AND OTHER ARTICLES. Jacob Bloch, Cincinnati. Filed Oct. 17, 1910. Similar to the preceding patent but has only one presser tube with an adjoining spring-pressed presser plate.

997,956. ANNUNCIATOR. Ira J. Bradshaw, Waukegan, Ill., assignor of one-half to John S. Butterfield, North Chicago, Ill. Filed Apr. 7, 1910. An electromagnet operates an indicating ratchet wheel through a link mechanism.

997,957. TROLLEY-HEAD. Peter Brandell, Wichita, Kans. Filed Apr. 23, 1910. A tubular head is screwed into the trolley pole. The head has a ring bearing for the trolley-wheel harp.

997,984. ELECTRIC STORAGE BATTERY. Bruce Ford, Philadelphia, Pa. Filed Dec. 13, 1907. Deflocculated graphite is mixed into a water solution of tannin, then the negative plates are treated with this solution till the graphite penetrates the pores of the active material and is precipitated therein, and the tannin is finally neutralized.

997,987. SAFETY SIGNALING DEVICE FOR GAS CONNECTIONS. Ferdinand Frey, Cleveland, O. Filed Nov. 2, 1910. An inclosing casing contains an inflated gas bag, a pair of electric terminals, and a circuit closer attached to an operating rod.

997,990. ELECTROMECHANICAL SELECTOR. Ernest Graham Godfree, Hampton, near Melbourne, Victoria, Australia. Filed May 7, 1910. Contains a mechanically controlled step-by-step selecting device that governs an electric circuit.

998,016. RECORDING MECHANISM FOR METERS. Robert C. Lanphier, Springfield, Ill., assignor to Sangamo Electric Co., Springfield, Ill. Filed March 22, 1911. A storage-battery meter is provided with an electromagnetically controlled polarized switch which governs the entrance of current to either of two branch circuits depending on whether the battery is being charged or discharged.

998,021. ILLUMINATING DEVICE. Herbert E. Marcy, Mount Vernon, N. Y., assignor of one-fourth to Gustave Nusskern, three-eighths to August Benkert, and three-eighths to William H. Pease, Mount Vernon, N. Y. Filed Oct. 15, 1910. A long rod has a handle at one end and an incandescent lamp and mirror adjustably pivoted at the other. The mirror is at right angles to the lamp and both can be adjusted angularly from the handle.

998,026. PRODUCTION OF PREDETERMINED DISTRIBUTION OF MAGNETIC FLUX IN ELECTRIC MOTORS, GENERATORS, AND OTHER APPARATUS. Ralph D. Mershon, New York, N. Y. Filed Apr. 11, 1907. Consists in causing the current in each lead to be divided into two or more currents of the same phase, and feeding these currents into the windings at a number of points per pole chosen with reference to the extent and location of the portions of the windings which the currents traverse, whereby the magnitude and distribution of the flux components produced by the resulting magneto-motive forces will be those requisite for a resultant flux having the distribution desired.

998,034. SIGNAL SYSTEM FOR ELEVATORS. David M. Perine, Pittsburg, Pa. Filed May 4, 1911. A bank of elevators is provided with an electric starting-signal system controlled by a clock. Each elevator has a signal at the top and bottom of the shaft and all the signals are operated so as to maintain a regular schedule with equal intervals between trips.

998,040. TELEPHONE SYSTEM. Harry O. Rugh, Sandwich, Ill., assignor to Sandwich Electric Co., Sandwich, Ill. Filed May 16, 1910. Relates to the arrangement of the terminal apparatus for phantom telephone circuits.

998,043. TELEPHONE SYSTEM. Raymond C. Smith, Homer, Mich. Filed Oct. 26, 1910. Operation of the switch hook governs a switch in the local transmitter and battery circuit.

998,063. ELECTROLYTIC CELLS FOR THE ELECTROLYSIS OF ALKALINE SALTS. Meyer Wildermann, Ealing, London, England. Filed Dec. 10, 1910. Is provided with a mercury cathode contained in super-imposed troughs, division ribs dipping into the mercury, stirrers for mixing the mercury and amalgam on the anode side, carbons floating on the mercury on the cathode side, and means for preventing the carbons from rising over a certain height in the troughs.

998,067. TERMINAL FOR INCANDESCING CONDUCTORS. Axel O. Appelberg, Schenectady, N. Y., assignor to General Electric Co. Filed July 2, 1906. A heat-radiating support for a tungsten filament consists of a coherent body of compressed tungsten powder.

998,071. SHADE-HOLDER FOR INCANDESCENT ELECTRIC LAMPS. William H. Burt, Waterbury, Conn., assignor to Waterbury Manufacturing Co., Waterbury, Conn. Filed May 8, 1911. The collar of the shell has a notch, opposite which a band is secured. The ends of the latter project through the notch and are drawn together by a screw.

998,073. ELECTRIC INSULATOR. George W. Chaffin, Dayton, O. Filed Feb. 13, 1911. A tubular metallic pin for the insulator has a bridge partly across the opening at its top and elastic material within the opening.

998,085. METHOD OF PRODUCING METALLIC VESSELS BY ELECTRODEPOSITION. Frank Iorns Gibbs, Birmingham, England. Filed Feb. 23, 1909. A vitreous model of the vessel with handle attached is prepared. This is coated with a conducting surface and on it is electrodeposited the desired metal. The body of the model is then cut away and metal deposited on the exposed surface of the handle so that the latter may be joined to the metallic body.

998,090. ELECTRIC SOCKET-SHELL AND SHADE-HOLDER. Jesper Hansen, Waterbury, Conn., assignor to Waterbury Manufacturing Co., Waterbury, Conn. Filed May 1, 1911. The shade-holder has a downwardly extending flange adapted to engage outwardly projecting nibs on the lower end of the socket.

998,108. INSULATED CONNECTION FOR METALLIC RAILWAY-TIES. Frank G. Metcalf, Bridgeport, Conn. Filed Apr. 10, 1911. Diagonal bolts extend from the tie to oblique supporting plates for the rail, the bolts being placed in insulating sleeves.

998,112. SUPPORT FOR ELECTRICAL CONDUCTORS. Thomas E. Murray, New York, N. Y. Filed Apr. 5, 1911. A vertical channel iron has V-shaped openings into which are secured V-shaped bracket arms bearing insulating cradles for the cables or busbars.

998,115. COMBINATION VOLTMETER, AMMETER AND PNEUMATIC PRESSURE GAGE. Lowell P. Norton, Los Angeles, Cal., assignor of one-half to Eugene Hoornbeek, Los Angeles, Cal. Filed Oct. 7, 1909. Has a pressure-indicating hand and an electrical index on the same dial. The stem of the case has an air connection and a pair of electrical connections.

998,117. TEMPERATURE-REGULATOR. Albert N. Ozias, Minneapolis, Minn. Filed July 20, 1910. A highly expansible side wall is connected through a flexible connection to a control arm between two circuit terminals.

998,119. ELECTRIC-SWITCH RECEPTACLE. Johann G. Peterson, Hartford, Conn., assignor to Arrow Electric Co., Hartford, Conn. Filed Mar. 22, 1910. Has notched ears for supporting it in position, and a face plate having means projecting from its back into the notches in such manner as to position the plate and hold it in place.

998,147. ALTERNATOR. Stratford B. Allen and Everett T. King, Cambridge, Mass. Filed Aug. 11, 1910. A switch comprises a pivoted insulating block having three arms mounted thereon and radiating from its pivotal center, an armature carried by one of the arms, an electromagnet energized by direct current for coöperating with the armature to oscillate the block, make-and-break contacts in the circuit of the electromagnet, condensers connected across the contacts, a pair of switch contacts carried by each of the other two arms, adjustable stationary contacts coöperating with the switch contacts, and a condenser connected across each pair of coöperating ontacts.

998,161. MAGNETIC TELEPHONE. William W. Dean, Elyria, Ohio, assignor to Dean Electric Co., Elyria, Ohio. Filed Mar. 29, 1909. The telephone receiver has a shell and cap holding the receiver cup in place. A number of E-shaped iron laminations are rigidly clamped together and detachably mounted in the cup.

998,175. METHOD OF AND APPARATUS FOR STARTING AND OPERATING MERCURY-VAPOR APPARATUS. Peter Cooper Hewitt, Ringwood Manor, N. J., assignor to Cooper Hewitt Electric Co. Filed Sept. 15, 1908. A quantity of solid matter adapted to dissolve in the mercury cathode of a mercury-vapor lamp is located in a restricted chamber communicating with the cathode chamber. In starting a momentary high voltage is applied to the electrodes.

998,183. TRIP DEVICE FOR ACTUATING ELECTRIC RAILWAY SWITCHING MECHANISM. Frank H. Kaiser, Buffalo, N. Y. Filed Dec. 19, 1908. Combined with a trolley-pole is a reciprocating trip-element air-actuated in one direction and spring-actuated in its other direction, and means to cause the trip-element to rotate during its reciprocating movement.

998,197. FIRE-ALARM APPARATUS. Guy T. Moore, Marlboro, Mass. Filed June 11, 1909. A sending device comprises a contact plate having a V-shaped slot therein, a shaft driven at a predetermined speed, a contact arm carried by the shaft, and means to adjust the contact arm to determine its time of passage over the slot.

998,212. ELECTRIC ARC LAMP. Stanislaw Szubert, Pankow, near Berlin, Germany. Filed Oct. 18, 1909. A converging-electrode flaming-arc lamp has two electromagnets which move the central pivot of an inclined set of levers upward and thus feed the electrodes secured to the lower ends of the levers.

998,223. ELECTRIC MERCURY-VAPOR LAMP. John M. Anck, Philadelphia, Pa.; William Anck, administrator of said John M. Anck, deceased, assignor of one-twelfth to John A. Wiedersheim, one-twelfth to William Caner Wiedersheim, one-twelfth to E. Hayward Fairbanks, and one-fourth to William Steell Jackson. Filed Dec. 14, 1904. Has a curved tube normally having its center higher than either end, means for rotating the tube, an electrode at one side of the tube near each end thereof, and mercury in the tube.

998,245. CONTROL SYSTEM FOR ELECTRIC MOTORS. Jay H. Hall, Cleveland, Ohio, assignor to Electric Controller & Manufacturing Co., Cleveland, O. Filed Mar. 18, 1910. A reversing starter and speed controller for a shunt motor has the resistance contacts arranged in circular form with a reversible contact arm bearing on the contacts.

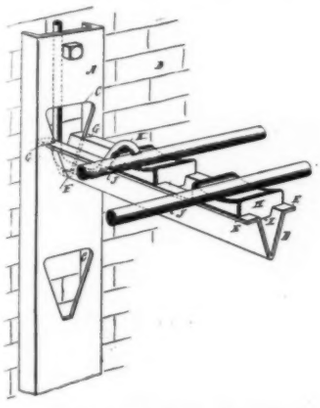
998,252 AUTOMATIC HIGH-TEMPERATURE-ALARM APPARATUS. John V. Lundstrom and Knud Nielsen, Schenectady, N. Y. Filed Feb. 16, 1910. A thermometer tube has two wire terminals adjustably mounted through its cap, these being connected to an electric alarm circuit.

998,260. AUTOMATIC TRAIN-STOPPING DEVICE. Franklin A. Pierce, Wheeling, W. Va., assignor of three-fourths to Joseph Gatewood, McMeechen, W. Va., Thomas Fitzgerald, Baltimore, Md., John E. Oswald and John T. Travers, Bellaire, O., Philip Conniff, Wheeling, W. Va., J. R. Onderdonk and A. P. Prendergast, Baltimore, Md. Filed Mar. 30, 1907. Renewed June 2, 1909. An electrically controlled means for applying the air brakes on a train.

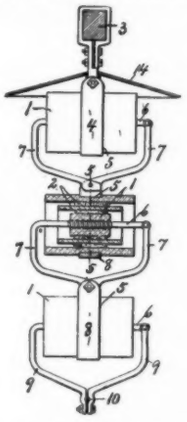
998,264 ELECTRIC MUSIC-SHEET-FEEDING DEVICE FOR SELF-PLAYING INSTRUMENTS Henry K. Sandell, Chicago, Ill. Assignor to Mills Novelty Co., Chicago, Ill. Filed Sept. 24, 1910. A motor drives a music-sheet take-up roller. A contact roller is supported in the path of the music-sheet to be frictionally rotated thereby, and intermeshing circuit-opening-and-closing toothed contact-wheels are arranged in the motor circuit, one being on the contact-roller.

998,269. ELECTRIC HEATING APPARATUS. Alexandre Trepreau, Joinville-le-Pont, France. Filed Oct. 25, 1910. An electric radiator has a series of glass tubes open at both ends, a frame in which the tubes are held, a resistance wire passed through the tubes permitting a free circulation of air through them.

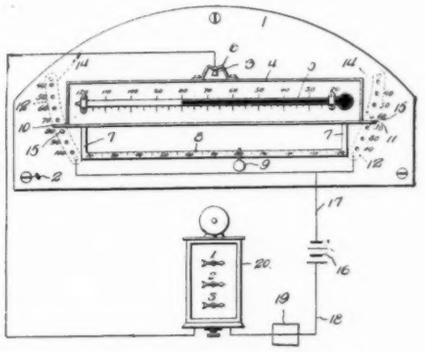
998,272. COLLECTOR-BRUSH FOR TORSIONMETERS. Archibald Barr and William Stroud, Anniesland, Glasgow, Scotland. Filed July 9, 1910. An electric contact brush is composed of an assemblage of rods, each having straight inner and outer end portions and a bend between them.



998,112.—CONDUCTOR SUPPORT.



998,359.—SUSPENSION INSULATOR.



998,485.—TEMPERATURE ALARM.

998,299. ELECTRIC SIGNALING SYSTEM. James G. Nolen and John Elden Shepherd, Chicago, Ill., assignors to Automatic Fire Protection Co., New York, N. Y. Filed May 2, 1908. Combined with a manually operable watchman's signal transmitter are alternative signaling circuits therefor, and a switch for localizing the signaling circuit of the transmitter to either circuit to the exclusion of the other.

998,301. ELECTRIC SWITCH. Carl A. Pfanstiehl, Highland Park, Ill., assignor to Pfanstiehl Electrical Laboratory, North Chicago, Ill. Filed Aug. 22, 1907. Within a circular casing is a pair of spring terminal fingers and a switch arm that is operated by a rotatable hub with a cross pin engaged by the split end of a key.

998,302. FIELD-MAGNET FOR ELECTRIC MOTORS AND GENERATORS. Alfred Edmund Reimers, Kansas City, Mo. Filed Apr. 28, 1906. Renewed Dec. 10, 1910. Comprises a yoke and a number of poles formed by cores having arms extending in opposite directions, each arm having an inner and an outer set of grooves, and series coils wound on the arms within the grooves thereof, and field coils wound on the cores and lying over the arms.

998,304. TERMINAL CLAMP. James D. Robertson, Toledo, Ohio, assignor to Champion Spark Plug Co., Toledo, O. Filed Aug. 5, 1910. Comprises a socketed holder, a wire like member bent upon itself to form a terminal receiving loop and having its leg terminals fashioned to fit within the holder and to interlock therewith to prevent a withdrawal of the legs, and an electrode projecting from the holder and having its inner end coacting with the legs to prevent a removal thereof.

998,343. PROTECTIVE DEVICE. Vladimir Karapetoff, Ithaca, N. Y., assignor to Allis-Chalmers Co. Filed June 28, 1909. Pro-

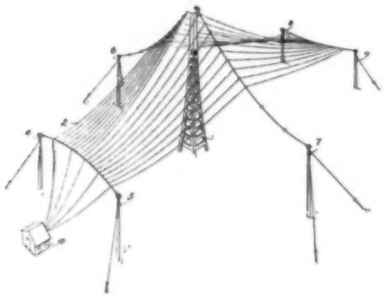
vides connections operative when the current in a circuit exceeds a predetermined value for energizing the motor to cause it to rotate in one direction at a speed which varies as the current in the circuit, and connections operative when the current in the circuit falls below such predetermined value for energizing the motor to cause it to rotate in the opposite direction back to initial position.

998,359. HIGH-VOLTAGE INSULATOR. Fred M. Locke, Victor, N. Y., assignor to Locke Insulator Manufacturing Co., Victor, N. Y. Filed Feb. 26, 1907. A suspension insulator set consists of a series of nested horizontal insulating units open at the ends and hangers joining the axis of each unit to the circumference of the next one.

998,361. MOTOR-CONTROLLER. Charles E. Lord, Milwaukee, Wis., assignor to Allis-Chalmers Co. Filed Oct. 25, 1909. A drum type controller includes a set of auto-transformers, contacts and contact fingers for bringing a three-phase motor through "starting," "running" and "off" conditions.

998,364. ELECTRICAL REGENERATIVE CONTROL APPARATUS AND SYSTEM. James Colquhoun Macfarlane and Harry Burge, Arc Works, Chelmsford, England, assignors to Crompton & Co., Arc Works, Chelmsford, England. Filed Feb. 7, 1910. Comprises a motor-generator having the motor connected in series with the generator element, a reversible shunt regulator for controlling the field of the generator, and a series-field winding on the generator for limiting the current drawn from the supply mains.

998,372. SAFETY ATTACHMENT FOR CARS. Robert S. Mills, St. Louis, Mo. Filed July 25, 1910. The fender has associated with it contact devices for closing the circuit of a solenoid-actuated valve in the air-brake system and for opening the motor circuit.



998,567.—ANTENNA FOR WIRELESS TELEGRAPHY.

998,375. COMBER AND STOP MOTION THEREFOR. Worthington E. Morton, Shelby, N. C. Filed Oct. 11, 1909. A sliver machine has an electrically actuated stop motion.

998,379. PROCESS OF ELECTROLYTIC REFINING OF ZINC. Kunigoro Namekawa, Jishichiro Miyazawa, Kumazo Miyabara and Shotaro Emura, Tokyo, Japan. Filed March 1, 1911. Consists in employing with a zinc sulphate solution a lead anode and a suitable cathode, in adding to the solution a compound of vegetable origin which has been heated almost to the point of carbonization, in passing a current from anode to cathode, and at intervals passing a current from the solution to the anode to remove any deposit that may have formed thereon.

998,386. COMMUTATOR FOR DYNAMO-ELECTRIC MACHINES. Charles Algernon Parsons and Alexander Henry Law, Newcastle-upon-Tyne, England. Filed April 19, 1909. Includes an operative set of commutator bars and anti-centrifugal means co-acting therewith together with separate means for retaining the shell co-axial with the shaft, said means including a member elastic longitudinally of the shaft and rigidly attached to the shell and on the other end to the shaft.

998,391. INDICATOR FOR HOTELS AND OTHER PLACES. Edwin L. Powell, New Orleans, La. Filed April 4, 1911. An annunciator has a series of translucent plates arranged in groups and an electric lamp for each plate.

998,392. DYNAMO-ELECTRIC MACHINE. Howard H. Ralston, Norwood, O., assignor to Allis-Chalmers Co. Filed Oct. 6, 1909. A brush rigging supported by the field frame has a brush yoke and a single series of radial arms each in the form of a flat plate secured at its outer end to the yoke and at its inner end having a brush-supporting rod.

998,419. SYSTEM OF MOTOR CONTROL. Halfdan A. Steen, Milwaukee, Wis., assignor to Allis-Chalmers Co. Filed Sept. 22, 1910. A controller of the separately actuated contact type having an actuating circuit for each contact controlled by an adjacent contact, and an electrically controlled master switch for controlling the operation of the contacts.

998,435. FUSE-SWITCH. Amos Lawrence Weekes, Harpenden, England. Filed May 3, 1910. Comprises a single switch arm, a bar of insulating material attached to the arm at right angles thereto, a fuse attached to the bar, a base on which the arm is pivoted, and means for completing the circuit through the fuse.

998,467. ELECTRIC SWITCH. Arthur W. Clauder, Bridgeport, Conn., assignor to Bryant Electric Co., Bridgeport, Conn. Filed Feb. 15, 1911. A keyed switch for an incandescent lamp socket.

998,485. AUTOMATIC ALARM. Alfred C. Farley and William B. McDonald, Shinglehouse, Pa.; said Farley assignor of one-third of his right to Charles A. Wolcott, Shinglehouse, Pa. Filed June 3, 1910. A normally horizontal swinging frame carries an electric contact at each end and is connected at its pivot with an alarm circuit. A horizontal thermometer mounted on the frame governs its balance so that either excess or deficient temperature causes the frame to tilt and close the alarm circuit.

998,486. ELECTROMAGNETIC SIFTER. Thomas Turner Fauntleroy, Staunton, Va. Filed April 1, 1911. A vertical iron cylinder is surrounded by an energizing coil rendering it a magnet. On top of the cylinder is a sieve and pendent from its center is an inverted funnel to deflect the material toward the cylinder walls.

998,551. TERMINAL CLAMP. James D. Robertson, Toledo, O. Filed Aug. 5, 1910. A wire is bent about itself to form a loop and has the ends twisted together and then coned to form a socket for connecting with a conductor.

998,552. ELECTROMAGNET. Harry O. Rugh, Sandwich, Ill., assignor to Sandwich Electric Co., Sandwich, Ill. Original application filed March 15, 1910. Divided and this application filed July 29, 1910. Has an actuating coil, an armature under the influence thereof, and means under the control of the armature to establish a short-circuited secondary for the actuating coil upon energization thereof.

998,564. ELECTROMAGNETIC CUTTING-TOOL. LeRoy T. Bonsall, Charleston, W. Va., assignor of one-third to Archibald A. Krieg, Charleston, W. Va. Filed March 22, 1909. A pair of solenoids is arranged longitudinally with a common reciprocating plunger core. Practically equivalent to an electric hammer.

998,567. SIGNALING BY ELECTROMAGNETIC WAVES. Reginald A. Fessenden, Washington, D. C., assignor to National Electric Signaling Co., Pittsburg, Pa. Filed Dec. 17, 1906. An antenna for wireless telegraphy comprises a series of wires lying in an oblique position with respect to the horizontal and having a horizontal component extending in the direction of propagation, the antenna being connected at the forward end to the telegraph instruments and being supported at the rear end by a ferro-concrete tower, which latter is thereby protected from useless absorption of the waves.

998,580. CIRCUIT-BREAKER. Augustus L. Horton, Beachmont, Mass., assignor to Sears B. Condit, Jr., Boston, Mass. Filed July 18, 1906. An oil-break switch with several vertically movable contacts operated by a vertically arranged toggle.

998,588. FIRE-PROTECTION SIGNAL SYSTEM. James G. Nolen, New York, N. Y., and John E. Shepherd, Charlottesville, Va., assignors to Automatic Fire Protection Co., New York, N. Y. Original application filed April 25, 1904. Divided and this application filed Sept. 3, 1909. The main circuit contains a central current source and alarm devices. A number of alarm-transmitting devices are arranged in separate subcircuits parallel to the main circuit.

PATENTS THAT HAVE EXPIRED.

Following is a list of the electrical patents (issued by the United States Patent Office), that expired July 24, 1911:

523,354. ELECTRICALLY PROPELLED PERAMBULATOR. Emil E. Keller, Chicago, Ill.

523,369. ELECTRICAL IGNITING DEVICE FOR GAS ENGINES. Alonzo J. Painter, Pasadena, Cal.

523,395. MULTIPLE-FILAMENT LAMP. Albert L. Clough, Manchester, N. H.

523,396. ELECTRIC RAILWAY SYSTEM. Albert C. Crehore, Ithaca, N. Y.

523,401. METHOD OF WORKING ARC LAMPS. William S. Horry, New York, N. Y.

523,444. CONTROLLING MECHANISM FOR ELECTRIC MOTORS Charles H. Richardson, Philadelphia, Pa.

523,400. INCANDESCENT ELECTRIC LAMP. Francis M. G Cazin, Hoboken, N. J.

523,461. ELECTRIC INCANDESCENT LAMP. Francis M G. Cazin, Hoboken, N. J.

523,471. ELECTRIC SNOW-PLOW. Louis J. Hirt, Somerville, Mass.

523,566. ELECTRICITY COUNTER. Francis A. Brocq, Paris, France.

523,572. ELECTRICAL CONVERTER. Robert H. Hassler, Dayton, O.

523,586. STARTING AND CONTROLLING DEVICE FOR ELECTRIC MOTORS. Joseph W. Moore, Boston, Mass.

523,613. TELEPHONE SWITCH. Jacon O. Ziegler, Boston, Mass.

523,617. SIGNAL TELEGRAPH. Claudius V. Broughton, Buffalo, N. Y.

523,630. TELEPHONE. Stephen D. Field, Stockbridge, Mass.